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10 **UNITED STATES DISTRICT COURT**  
11 **CENTRAL DISTRICT OF CALIFORNIA**  
12 **WESTERN DIVISION**

14 EDIE GOLIKOV, individually and on  
behalf of all others similarly situated,

15 Plaintiff,

16 v.

17 WALMART INC.,

18 Defendant.  
19  
20  
21  
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Case No. 2:24-CV-08211-RGK-MAR

Assigned to Honorable R. Gary  
Klausner

**DECLARATION OF JACOB M.  
HARPER IN SUPPORT OF JOINT  
STIPULATION PURSUANT TO  
LOCAL RULE 37 FOR  
DEFENDANT'S MOTION TO  
COMPEL FURTHER RESPONSES  
TO REQUESTS FOR  
PRODUCTION**

Date: June 11, 2025  
Time: 11:00 a.m.  
Location: Courtroom 790

Assigned to the Hon. Margo A. Rocconi

Discovery Cut-Off: June 24, 2025  
Pretrial Conference: September 8, 2025  
Trial Date: September 23, 2025

**DECLARATION OF JACOB M. HARPER**

I, Jacob M. Harper, declare and state as follows:

1. I am a partner with the law firm of Davis Wright Tremaine LLP, counsel for defendant Walmart Inc. (Walmart) in this matter. I make this declaration in support of the parties' Joint Stipulation Pursuant to Local Rule 37 for Defendant's Motion to Compel Further Responses to Requests for Production. I have personal knowledge of the facts set forth in this declaration, and if called as a witness, I could and would competently testify to them.

2. Attached as **Exhibit A** is a true and correct copy of the Court's Scheduling Order, filed in this action at Dkt. 57, obtained at my direction from the Court's docket.

3. Attached as **Exhibit B** is a true and correct copy of Plaintiff Edie Golikov's First Amended Complaint, filed in this action at Dkt. 31, obtained at my direction from the Court's docket.

4. Attached as **Exhibit C** is a true and correct copy of the Declaration of Richard Lyon in Support of Plaintiff's Motion for Class Certification, filed in this action at Dkt. 33-3, obtained at my direction from the Court's docket.

5. Attached as **Exhibit D** is a true and correct copy of the Declaration of Imel Courtland in Support of Plaintiff's Opposition to Defendant's Motion to Dismiss, filed in this action at Dkt. 41-1, obtained at my direction from the Court's docket.

6. Attached as **Exhibit E** is a true and correct copy of the Declaration of Walmart's Avocado Oil Supplier in Support of Walmart's Opposition to Plaintiff's Motion for Class Certification, filed in this action at Dkt. 43-3, obtained at my direction from the Court's docket.

7. Attached as **Exhibit F** is a true and correct copy of the Court's Order Partially Granting Defendant's Motion to Dismiss, filed in this action at Dkt. 63, obtained at my direction from the Court's docket.

1           8.     On January 23, 2025, my office (on Walmart's behalf) served Ms.  
2 Golikov through counsel with Walmart's first set of requests for production.  
3 Attached as **Exhibit G** is a true and correct copy of Walmart's as-served requests  
4 for production.

5           9.     On March 10, 2025, Ms. Golikov's counsel served my office (for  
6 Walmart) her responses to Walmart's first set of requests for production. Attached  
7 as **Exhibit H** is a true and correct copy of Ms. Golikov's verified responses to  
8 Walmart's First Set of Requests for Production.

9           10.    On March 31, 2025, my office (on Walmart's behalf) served Ms.  
10 Golikov through counsel with a meet and confer letter regarding Ms. Golikov's  
11 responses to Walmart's first set of requests for production. Attached as **Exhibit I** is  
12 a true and correct copy of Walmart's March 31, 2025 Meet and Confer Letter to  
13 Plaintiff regarding Plaintiff's Responses to Walmart's First Set of Requests for  
14 Production.

15           11.    On April 4, 2025, I had a conferral call with Plaintiff's counsel Rick  
16 Lyon, where I raised the discovery disputes raised in Walmart's March 31, 2025  
17 letter. Plaintiff's counsel was not prepared to substantively discuss most, if any, of  
18 Walmart's identified deficiencies. Plaintiff and her counsel did not otherwise  
19 respond to the letter or make any attempt to confer regarding the discovery disputes  
20 raised in Walmart's March 31, 2025 letter.

21           12.    Attached as **Exhibit J** is a true and correct copy of Docket Number  
22 145-6 in *Jennifer Bennett et al. v. Quest Diagnostics, Inc.*, No. 17-1590 (D.N.J.)  
23 (closed June 26, 2023), obtained at my direction from PACER.

24           13.    Attached as **Exhibit K** is a true and correct copy of the Declaration of  
25 Plaintiff Edie Golikov in Support of Plaintiff's Motion for Class Certification, filed  
26 in this action at Dkt. 36-1, obtained at my direction from the Court's docket.

1 14. Attached as **Exhibit L** is a true and correct copy of the Declaration of  
2 Richard Lyon in Support of Plaintiff's Motion for Class Certification, filed in this  
3 action at Dkt. 36-3, obtained at my direction from the Court's docket.

4 15. On May 2, 2025, Plaintiff made her first and only production of  
5 documents (as of the date of this declaration) via email. The production was 82  
6 pages, 75 pages of which appear to be publicly available, third-party reports and  
7 newspaper articles, all of which were cited in the First Amended Complaint.  
8 Plaintiff also produced, at Bates number GOLIKOV000002, an incomplete print out  
9 of a November 14, 2021 order from Walmart.com of the Great Value Refined  
10 Avocado Oil that appears to only include the first of three pages. This production  
11 does not address or resolve the discovery disputes raised in the Walmart's March 31,  
12 2025 conferral letter. A true and correct copy the document Plaintiff produced in  
13 this action bearing Bates number GOLIKOV000002 is attached as **Exhibit M**.

14 16. Plaintiff's May 2, 2025 production also included a document, bearing  
15 Bates number GOLIKOV000001, that appears to be an illegible printout of an  
16 October 9, 2023 order from Target.com. A true and correct copy the document  
17 Plaintiff produced in this action bearing Bates number GOLIKOV000001 is  
18 attached as **Exhibit N**.

19 I declare under penalty of perjury under the laws of the United States that the  
20 foregoing is true and correct to the best of my knowledge and belief.

21 Executed this 21st day of May, 2025, at Los Angeles, California.

22 \_\_\_\_\_  
23 /s/ *Jacob M. Harper*

24 Jacob M. Harper  
25  
26  
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# **EXHIBIT A**

UNITED STATES DISTRICT COURT  
CENTRAL DISTRICT OF CALIFORNIA

CIVIL MINUTES – GENERAL

Case No. 2:24-cv-08211-RGK-MAR

Date 2/10/2025

Title EDDIE GOLIKOV V. WALMART INC.

Present : The Honorable R. GARY KLAUSNER, UNITED STATES DISTRICT JUDGE

Joseph Remigio

Marea Woolrich

N/A

Deputy Clerk

Court Reporter / Recorder

Tape No.

Attorneys Present for Plaintiffs:

Attorneys Present for Defendants:

Richard Lyon, III

Jacob Harper

**Proceedings: SCHEDULING CONFERENCE**

Case called. Court and counsel confer. The Scheduling Conference is held and the Court sets the following dates:

Jury Trial (Est. 4 days):

September 23, 2025 at 09:00 AM

Pretrial Conference:

September 8, 2025 at 09:00 AM

Motion Cut-Off Date (last day to file):

July 8, 2025

Discovery Cut-Off Date (fact discovery):

June 24, 2025

Last day to amend the complaint or add parties is 3/30/2025. The parties shall participate in ADR SP3.

**IT IS SO ORDERED.**

Initials of Preparer: jre<sup>:02</sup>

# **EXHIBIT B**

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*Attorneys for Plaintiff*

**UNITED STATES DISTRICT COURT  
CENTRAL DISTRICT OF CALIFORNIA**

EDIE GOLIKOV, individually and  
on behalf of all others similarly  
situated,

*Plaintiff,*

v.

WALMART INC.,

*Defendant.*

Case No. 2:24-cv-08211

**FIRST AMENDED CLASS ACTION  
COMPLAINT**

**DEMAND FOR JURY TRIAL**

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**I. Introduction.**

1. Supermarkets today are stocked with a variety of cooking oils. Customers can choose different cooking oils based on factors such as taste, uses, health benefits, and price.

2. “Avocado oil is a rising star in the culinary world.”<sup>1</sup> It “has generated growing interest among consumers due to its nutritional and technological characteristics.”<sup>2</sup> Avocado oil “is delicious, nutritious, and easy to use. It’s rich in oleic acid, polyunsaturated fats, carotenoids, and other antioxidant-rich nutrients that are linked to improved heart, skin, and eye health.”<sup>3</sup> It has a variety of health benefits, and may reduce arthritis and improve skin. It also has a high heat point, which makes it suitable for high heat cooking.<sup>4</sup> “[A]vocado oil has established itself as an oil that has a very good nutritional value at low and high temperatures.”<sup>5</sup>

3. Because of its many benefits, consumers seek out avocado oil, and are willing to pay more for it. And, avocado oil can command prices four times more expensive than its competitor, canola oil.<sup>6</sup>

4. But because avocado oil is more expensive to produce, some makers cut corners. They substitute other oils, or mix avocado oil with cheaper seed oils. They sell avocado oil that is adulterated. Consumers are harmed. They buy products labeled “avocado oil,” believing that they are buying unadulterated avocado oil, and in fact receive impure oil that is adulterated.

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<sup>1</sup> <https://www.washingtonpost.com/wellness/2024/08/27/avocado-oil-adulteration-tests/>

<sup>2</sup> <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6600360/>

<sup>3</sup> <https://www.healthline.com/nutrition/9-avocado-oil-benefits>

<sup>4</sup> [https://www.healthline.com/nutrition/9-avocado-oil-benefits#TOC\\_TITLE\\_HDR\\_2](https://www.healthline.com/nutrition/9-avocado-oil-benefits#TOC_TITLE_HDR_2)

<sup>5</sup> <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6600360/>;  
<https://healthnews.com/nutrition/healthy-eating/why-you-should-start-replacing-canola-oil-with-avocado-oil/>

<sup>6</sup> *Id.*

1           5. Defendant Walmart Inc. (“Walmart” or “Defendant”) makes, markets and  
2 sells Great Value brand avocado oil. The bottle prominently states that it contains only  
3 avocado oil. The bottle is labeled “Refined Avocado Oil,” and has pictures of avocados.  
4 The ingredient list also lists only “avocado oil.” But the truth is, it is not unadulterated  
5 avocado oil. Instead, testing has shown that the oil is adulterated.

6           6. On November 14, 2021 Plaintiff Edie Golikov purchased a bottle of Great  
7 Value Refined Avocado Oil from a Walmart store while living in Tarzana, California.  
8 When Ms. Golikov purchased the product, the package prominently stated “Avocado  
9 Oil.” She read and relied on this statement, and believed she was purchasing  
10 unadulterated avocado oil. But a recent study shows that this is not true; Defendant’s  
11 avocado oil is adulterated. Plaintiff was harmed, and brings this lawsuit on behalf of  
12 herself and a class of consumers that purchased Defendant’s avocado oil.

13 **II. Parties.**

14           7. Plaintiff Edie Golikov is a citizen of California, domiciled in Los Angeles  
15 County.

16           8. The proposed class includes citizens of every state.

17           9. Defendant Walmart, Inc. is a Delaware Corporation with its principal place  
18 of business at 702 SW 8th St., Bentonville, AR 72716.

19 **III. Jurisdiction and Venue.**

20           10. This Court has subject matter jurisdiction under 28 U.S.C. § 1332(d)(2).  
21 The amount in controversy exceeds \$5,000,000, exclusive of interest and costs, and the  
22 matter is a class action in which one or more members of the proposed class are citizens  
23 of a state different from Defendant.

24           11. The Court has personal jurisdiction over Defendant because Defendant  
25 sold Great Value Products to consumers in California, including to Plaintiff.

26           12. Venue is proper under 28 U.S.C. § 1391(b)(1) and 28 U.S.C. § 1391(d)  
27 because Defendant would be subject to personal jurisdiction in this District if this  
28 District were a separate state, given that Defendant sold Great Value Products to



1 consumers in this District, including Plaintiff. Venue is also proper under 28 U.S.C. §  
2 1391(b)(2) because a substantial part of Defendant's conduct giving rise to the claims  
3 occurred in this District, including Defendant's sale to Plaintiff.

4 **IV. Facts.**

5 **A. Consumers want unadulterated avocado oil, and are willing to pay**  
6 **more for it.**

7 13. Avocado oil is quickly gaining popularity in the culinary world. It has  
8 attracted increasing attention from consumers due to its nutritional benefits and  
9 versatility. Avocado oil has mild flavor, making it easy to cook with. In addition, it is  
10 packed with healthful nutrients like oleic acid, polyunsaturated fats, carotenoids, and  
11 antioxidants, which have been linked to better heart, skin, and eye health. Avocado oil  
12 may also improve arthritis and promote healthy skin. Additionally, avocado oil's high  
13 smoke point makes it ideal for cooking at high temperatures. This makes it a versatile oil  
14 with excellent nutritional value, whether used at low or high heat.

15 14. Due to its numerous health benefits, avocado oil is highly sought after by  
16 consumers, who are often willing to pay a premium for it. In fact, avocado oil can be  
17 priced up to four times higher than its competitor, canola oil.<sup>7</sup>

18 **B. Scientific research reveals problems with avocado oil labeling.**

19 15. Unfortunately, "due to the lack of enforceable standards, consumers are  
20 unprotected from fraud (i.e., economic motivated adulteration)" in the avocado oil  
21 marketplace.<sup>8</sup> In a statement, the Food and Drug Administration acknowledged that  
22 "high value oils" such as avocado oil "are potential targets for economically motivated  
23 adulteration." Because it costs a lot more to make unadulterated avocado oil than an  
24 adulterated oil (e.g. one containing a mix of avocado and other oils or ingredients), bad  
25 actors can increase their profits by selling impure or mixed oils as unadulterated avocado

26 <sup>7</sup> <https://healthnews.com/nutrition/healthy-eating/why-you-should-start-replacing-canola-oil-with-avocado-oil/>  
27

28 <sup>8</sup> Green, H. S.; Wang, S. C. Food Control, 2020, 116, 107328: "First report on  
quality and purity evaluations of avocado oil sold in the US", available at  
<https://www.sciencedirect.com/science/article/pii/S0956713520302449>

oil.<sup>9</sup> “Oils that are of poor quality or blended with cheaper edible oil can be traded and sold”<sup>10</sup> to unknowing consumers. Consumers purchase the inauthentic products and pay the higher prices, believing that they are purchasing unadulterated avocado oil with its corresponding benefits.

16. A group of scientists at University of California, Davis recently tested a variety of commercially available avocado oil for adulteration. They noted that “the most effective way to determine [avocado oil] purity is to use both sterols and fatty acid profile” tests.<sup>11</sup> Sterols are plant-based compounds unique to certain oils. Avocado oil has a characteristic sterol profile, and if the sterol composition of a product deviates from the norm for avocado oil, that deviation indicates adulteration. The fatty acid profile test includes the proportions of various fatty acids present in the tested oil, such as oleic acid, stearic acid, and others. Unadulterated avocado oil has a specific range of fatty acids that reflect its natural composition. Adulterated avocado oil exhibits fatty acid levels outside this expected range. Specific patterns in fatty acid profiles help pinpoint which oils (e.g., canola oil) have been mixed with the avocado oil. Based on these and other tests, the UC Davis researchers found that many retailers were selling adulterated avocado oil. Almost 70% of the avocado oils tested were “rancid or mixed with other oils.”<sup>12</sup>

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<sup>9</sup> Green, H. S.; Wang, S. C. Food Control 2023, 152, 109837 “Purity and quality of private labelled avocado oil,” available at <https://www.sciencedirect.com/science/article/pii/S0956713523002372>

<sup>10</sup> Green, H. S.; Wang, S. C. Food Control, 2020, 116, 107328: “First report on quality and purity evaluations of avocado oil sold in the US”, available at <https://www.sciencedirect.com/science/article/pii/S0956713520302449>

<sup>11</sup> Green, H. S.; Wang, S. C. Food Control 2023, 152, 109837 “Purity and quality of private labelled avocado oil,” available at <https://www.sciencedirect.com/science/article/pii/S0956713523002372>

<sup>12</sup> <https://www.ucdavis.edu/food/news/70%25-private-label-avocado-oil-rancid-or-mixed-other-oils>

**C. Defendant's avocado oil labeling is false and misleading.**

17. Defendant sells Great Value Avocado Oil (the "Product"). Defendant's labels prominently state that the Product is avocado oil. The front of the bottle prominently states "Avocado Oil," and includes images of avocados.



18. The ingredients lists only a single ingredient: Avocado Oil.



19. Based on each of these representations, reasonable consumers believe that the bottle contains avocado oil, and *only* avocado oil. Reasonable consumers expect that the words “Avocado Oil” means that the bottles contain avocado oil, not some oil that is adulterated with other oils or substances. Similarly, when reasonable consumers see the sole ingredient: “avocado oil,” they expect that the product only includes that sole ingredient: avocado oil. No reasonable consumer expects that a bottle labeled “Avocado Oil,” featuring photos of avocados, and listing only “avocado oil” as its ingredient contains other, cheaper, non-avocado oils. A reasonable consumer would attach importance to the accuracy of the ingredients listed on a product when deciding whether

1 to purchase it. In short, reasonable consumers reasonably believe that they are receiving a  
2 product that contains only avocado oil.

3 20. But, scientific testing shows that the avocado oil is adulterated. The  
4 University of California, Davis researchers who study avocado oil purity recently revealed  
5 the names of the avocado oils that had tested adulterated in their study. The list included  
6 Defendant's Great Value Avocado Oil.<sup>13</sup> According to the researchers, Defendant's  
7 Great Value Avocado Oil contains high levels of other oils, including oleic sunflower or  
8 safflower oils—two oils that are less expensive than avocado oil and that have different  
9 health and culinary properties. And Great Value Avocado Oil failed both a fatty acid  
10 profile and sterol test—the two test that the researchers found to be the most important  
11 to determine whether avocado oil is adulterated.<sup>14</sup>

12 21. The inaccurate labeling of Defendant's product is highly material to  
13 reasonable consumers. Consumers who purchase avocado oil attach importance to the  
14 representation that the products contain only avocado oil, because they believe avocado  
15 oil has benefits over other oils. That importance is reflected in the fact that consumers  
16 choose to pay more for avocado oil products, because they believe that the products that  
17 they are receiving are unadulterated avocado oil, and not an oil that is adulterated with  
18 cheaper oils.

19 22. Defendant knows, or reasonably should know, that its labeling is misleading  
20 customers. Since at least 2020, the avocado oil industry has been aware that there are  
21 problems with adulteration and purity of avocado oils. *See, e.g.*,  
22 <https://www.sciencedirect.com/science/article/pii/S0956713520302449?>

23 23. As a distributor and seller of cooking oils, Defendant is aware of industry  
24 studies and trends, and aware of the problems with adulteration in the avocado oil market.  
25 Defendant is aware of, willfully blind to, or negligent with respect to the fact that the  
26 avocado oils that it sells are adulterated. Indeed, if Defendant tested its own avocado oils

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27 <sup>13</sup> [https://www.washingtonpost.com/wellness/2024/08/27/avocado-oil-adulteration-](https://www.washingtonpost.com/wellness/2024/08/27/avocado-oil-adulteration-tests/)  
28 [tests/](https://www.washingtonpost.com/wellness/2024/08/27/avocado-oil-adulteration-tests/)

<sup>14</sup> *Id.*

1 before putting them on the market, it would know that its avocado oils are adulterated.  
2 Given the pervasive problems with avocado oil adulteration, any reasonable maker, seller,  
3 or distributor of avocado oil would test its own products.

4 **D. Defendant overcharges its consumers.**

5 24. Defendant's false and misleading labeling allows Defendant to charge higher  
6 prices for its Products. As explained above, consumers are willing to pay substantially  
7 higher prices for avocado oil. If Defendant told the truth—that its oils are adulterated  
8 with other oils—the price of its avocado oil would drop dramatically. If consumers knew  
9 the truth—that the Products did not contain only avocado oil—they would not pay the  
10 current prices for the Products and, in fact, would not purchase the Products at all.  
11 Indeed, as described above, other oils sell for substantially less than unadulterated  
12 avocado oil, and consumers purchase avocado oil because of its unique health and  
13 culinary benefits. Accordingly, if Defendant accurately labeled its Product, consumers  
14 would not have purchased the Products or would have paid less for the Products.

15 25. Thus, Plaintiff and each class member purchased a product they wouldn't  
16 have otherwise purchased and paid a substantial price premium because of Defendant's  
17 false and misleading labeling. Plaintiff paid for a superior product worth more, and  
18 received an inferior product that was inaccurately labeled. Plaintiff and the class therefore  
19 sustained an economic injury and purchased a Product they would not have otherwise  
20 purchased and paid a price premium as result of Defendant's false and misleading labels.

21 **E. Plaintiff was misled and harmed by Defendant's false and misleading**  
22 **labeling.**

23 26. On November 14, 2021 Plaintiff Edie Golikov purchased a bottle of Great  
24 Value Refined Avocado Oil from a Walmart store while living in Tarzana, California. The  
25 package prominently stated "Avocado Oil" and had pictures of avocados. The ingredient  
26 list also listed only avocado oil. Ms. Golikov read and relied on these statements when  
27 purchasing the Product. She would not have purchased the Product if she had known  
28 that the Product was contaminated with other oils, or she would have paid less for it.



27. Plaintiff wants Walmart to fix its practices and sell avocado oil with accurate labeling. If Walmart fixes their Products, so that the avocado oil is actually unadulterated and not contaminated with other oils, she would buy them again. But given Walmart's past deception, Plaintiff cannot rely on Walmart's word alone that it has fixed the problem. Plaintiff faces an imminent threat of harm because she will not be able to rely on Walmart's labels in the future, and will not be able to buy Great Value Avocado Oil, even if Walmart claims to have fixed the issue. To buy Walmart's Products again, Plaintiff needs the Court to enter an order forbidding Walmart from claiming that its avocado oil contains only "avocado oil," unless the avocado oil actually is unadulterated and not contaminated with other oils.

**F. No adequate remedy at law.**

28. Plaintiff seeks damages and, in the alternative, restitution. Plaintiff is permitted to seek equitable remedies in the alternative because he has no adequate remedy at law.

29. A legal remedy is not adequate if it is not as certain as an equitable remedy. The elements of Plaintiff's equitable claims are different and do not require the same showings as Plaintiff's legal claims. As one example, to obtain damages under the CLRA, a plaintiff must show that they complied with the CLRA's notice requirement for damages. No such requirements exist to obtain restitution. Because a plaintiff must make this additional showing to obtain damages, rather than restitution, the legal remedies are more uncertain.

30. In addition, the remedies at law available to Plaintiff are not equally prompt or otherwise efficient. The need to schedule a jury trial may result in delay. And a jury trial will take longer, and be more expensive, than a bench trial.

**V. Class Action allegations.**

31. Plaintiff brings the asserted claims on behalf of the proposed class of:

- Nationwide Class: all persons who, within the applicable statute of limitations period, purchased Great Value Avocado Oil.



- California Subclass: all persons who, while in the state of California and within the applicable statute of limitations period, purchased Great Value Avocado Oil.

32. The following people are excluded from the class: (1) any Judge or Magistrate Judge presiding over this action and the members of their family; (2) Defendant, Defendant's subsidiaries, parents, successors, predecessors, and any entity in which the Defendant or its parents have a controlling interest and their current employees, officers, and directors; (3) persons who properly execute and file a timely request for exclusion from the class; (4) persons whose claims in this matter have been finally adjudicated on the merits or otherwise released; (5) Plaintiff's counsel and Defendant's counsel, and their experts and consultants; and (6) the legal representatives, successors, and assigns of any such excluded persons.

***Numerosity & Ascertainability***

33. The proposed class contains members so numerous that separate joinder of each member of the class is impractical. There are tens or hundreds of thousands of class members.

34. Class members can be identified through Defendant's sales records and public notice.

***Predominance of Common Questions***

35. There are questions of law and fact common to the proposed class. Common questions of law and fact include, without limitation:

- (1) whether Defendant made false or misleading statements of fact in its advertisements;
- (2) whether Defendant violated California's consumer protection statutes;
- (3) whether Defendant committed a breach of contract;
- (4) whether Defendant committed a breach of an express warranty;
- (5) damages needed to reasonably compensate Plaintiff and the proposed class.

1           *Typicality & Adequacy*

2           36. Plaintiff's claims are typical of the proposed class. Like the proposed class,  
3 Plaintiff purchased Defendant's Great Value Avocado Oil Products. There are no  
4 conflicts of interest between Plaintiff and the class.

5           *Superiority*

6           37. A class action is superior to all other available methods for the fair and  
7 efficient adjudication of this litigation because individual litigation of each claim is  
8 impractical. It would be unduly burdensome to have individual litigation of millions of  
9 individual claims in separate lawsuits, every one of which would present the issues  
10 presented in this lawsuit.

11       **VI. Claims.**

12                               **First Cause of Action:**

13       **Violation of California's False Advertising Law Bus. & Prof. Code §§ 17500 &**  
14                               **17501 et. seq.**

15                               **(By Plaintiff and the California Subclass)**

16           38. Plaintiff incorporates each and every factual allegation set forth above.

17           39. Plaintiff brings this cause of action individually and on behalf of herself and  
18 members of the California Subclass.

19           40. Defendant has violated Sections 17500 and 17501 of the Business and  
20 Professions Code.

21           41. Defendant has violated, and continues to violate, Section 17500 of the  
22 Business and Professions Code by disseminating untrue and misleading advertisements to  
23 Plaintiff and subclass members.

24           42. As alleged in detail above, Defendant falsely advertised its products by  
25 falsely representing that Great Value Avocado Oil is pure avocado oil. It did this by  
26 prominently labeling the bottle "Avocado Oil," featuring avocados on the bottle, and also  
27 by listing only "Avocado Oil" in the ingredients list.

43. Defendant's misrepresentations were likely to deceive, and did deceive, Plaintiff and other reasonable consumers. Defendant knew, or should have known through the exercise of reasonable care, that these statements were false and misleading.

44. Defendant's misrepresentations were intended to induce reliance, and Plaintiff saw, read, and reasonably relied on them when purchasing Defendant's Products. Classwide reliance can be inferred because Defendant's misrepresentations and omissions were material, i.e., a reasonable consumer would consider them important in deciding whether to buy the products.

45. Defendant's misrepresentations were a substantial factor in Plaintiff's purchase decision and the purchase decisions of subclass members.

46. Plaintiff and the subclass were injured as a direct and proximate result of Defendant's conduct because: (a) they would not have purchased Great Value Avocado Oil if they had known that the Product is impure and contaminated with a different oil or oils, and (b) they overpaid for the Product because it was sold at a price premium due to the representation.

**Second Cause of Action:**

**Violation of California's Consumer Legal Remedies Act  
(by Plaintiff and the California Subclass)**

47. Plaintiff incorporates each and every factual allegation set forth above.

48. Plaintiff brings this cause of action individually and on behalf of herself and members of the California Subclass.

49. Plaintiff and the class are "consumers," as the term is defined by California Civil Code § 1761(d).

50. Plaintiff and the subclass have engaged in "transactions" with Defendant as that term is defined by California Civil Code § 1761(e).

51. The conduct alleged in this Complaint constitutes unfair methods of competition and unfair and deceptive acts and practices for the purpose of the CLRA,

1 and the conduct was undertaken by Defendant in transactions intended to result in, and  
2 which did result in, the sale of goods to consumers.

3 52. As alleged more fully above, Defendant has violated the CLRA by falsely  
4 representing that Great Value Avocado Oil contains only avocado oil, when in fact the  
5 products are impure and contaminated with a different oil or oils. Defendant knew, or  
6 should have known through the exercise of reasonable care, that these statements were  
7 false and misleading.

8 53. Defendant violated, and continues to violate, Section 1770(a)(5) of the  
9 California Civil Code by representing that goods have “characteristics, ingredients, uses,  
10 benefits, or quantities which they do not have.” Defendant represents that its Products  
11 have the characteristic of being avocado oil and only avocado oil, when in reality they are  
12 impure and mixed or substituted with a different oil or oils. Defendant represents that its  
13 Product contains only avocado oil, when in fact it is adulterated with other oils.

14 54. Defendant violated, and continues to violate, Section 1770(a)(7) of the  
15 California Civil Code by “[r]epresenting that goods or services are of a particular standard,  
16 quality, or grade . . . if they are another.” Defendant represents that its Products meet the  
17 standard of containing only avocado oil, when in reality they are impure and mixed or  
18 substituted with a different oil or oils. Defendant represents that its Product contains  
19 only avocado oil, when in fact it is adulterated with other oils.

20 55. Defendant violated, and continues to violate, Section 1770(a)(9) of the  
21 California Civil Code by advertising “goods...with intent not to sell them as advertised.”  
22 Defendant advertises that its Product contains only avocado oil, when in fact it is  
23 adulterated with other oils.

24 56. Defendant’s representations were likely to deceive, and did deceive, Plaintiff  
25 and reasonable consumers. Defendant knew, or should have known through the exercise  
26 of reasonable care, that these statements were inaccurate and misleading.

1           57. Defendant's misrepresentations were intended to induce reliance, and  
2 Plaintiff saw, read, and reasonably relied on them when purchasing the Products.  
3 Defendant's misrepresentations were a substantial factor in Plaintiff's purchase decision.

4           58. In addition, subclass-wide reliance can be inferred because Defendant's  
5 misrepresentations were material, i.e., a reasonable consumer would consider them  
6 important in deciding whether to buy the Products.

7           59. Defendant's misrepresentations were a substantial factor and proximate  
8 cause in causing damages and losses to Plaintiff and the subclass.

9           60. Plaintiff and the subclass were injured as a direct and proximate result of  
10 Defendant's conduct because: (a) they would not have purchased Great Value Avocado  
11 Oil if they had known that the Product is impure and contaminated with a different oil or  
12 oils, and (b) they overpaid for the Product because it was sold at a price premium due to  
13 the representation.

14           61. Accordingly, pursuant to California Civil Code § 1780(a)(2), Ms. Golikov, on  
15 behalf of herself and all other members of the subclass, seeks injunctive relief.

16           62. CLRA § 1782 NOTICE. On September 20, 2024, a CLRA demand letter  
17 was sent to Defendant's California registered agent and Arkansas headquarters via  
18 certified mail (return receipt requested), that provided notice of Defendant's violations of  
19 the CLRA and demanded that Defendant correct the unlawful, unfair, false and/or  
20 deceptive practices alleged here. If Defendant does not fully correct the problem for  
21 Plaintiff and for each member of the California Subclass within 30 days of receipt,  
22 Plaintiff and the California Subclass will seek all monetary relief allowed under the CLRA.

23           63. A CLRA venue declaration is attached.

24                           **Third Cause of Action:**

25                           **Violation of California's Unfair Competition Law**  
26                           **(by Plaintiff and the California Subclass)**

27           64. Plaintiff incorporates each and every factual allegation set forth above.  
28

65. Plaintiff brings this cause of action individually and on behalf of herself and members of the California Subclass.

66. Defendant has violated California's Unfair Competition Law (UCL) by engaging in unlawful, fraudulent, and unfair conduct (i.e., violating each of the three prongs of the UCL).

***The Unlawful Prong.***

67. Defendant engaged in unlawful conduct by violating the CLRA and FAL, as alleged above and incorporated here.

***The Fraudulent Prong.***

68. As alleged in detail above, Defendant's representations that its Products contained only avocado were false and misleading. Its labeling is likely to deceive, and did deceive, Plaintiff and other reasonable consumers

***The Unfair Prong.***

69. Defendant's conduct, as detailed above, also violated the "unfair" prong of the UCL.

70. Defendant's conduct caused substantial injury to Plaintiff and subclass members. The harm to Plaintiff and the subclass greatly outweighs the public utility of Defendant's conduct (which is none). Inaccurately labeled avocado oil has no public utility. This injury was not outweighed by any countervailing benefits to consumers or competition. Misleading labels only injure healthy competition and harm consumers.

71. Plaintiff and the subclass could not have reasonably avoided this injury. As alleged above, Defendant's labeling is false and misleading. Its labeling is likely to deceive, and did deceive reasonable consumers like Plaintiff.

72. Defendant's conduct, as alleged above, was immoral, unethical, oppressive, unscrupulous, and substantially injurious to consumers.

73. Defendant's conduct violated the public policy against false and misleading labels, which is tethered to the CLRA and the FAL.

\* \* \*

74. For all prongs, Defendant's misrepresentations and omissions were intended to induce reliance, and Plaintiff saw, read, and reasonably relied on the statements when purchasing the Products. In addition, subclass-wide reliance can be inferred because Defendant's misrepresentations were material, i.e., a reasonable consumer would consider them important in deciding whether to buy the Products.

75. Defendant's misrepresentations were a substantial factor in Plaintiff's purchase decision and the purchase decision of subclass members.

76. Plaintiff and the subclass were injured as a direct and proximate result of Defendant's conduct because: (a) they would not have purchased Great Value Avocado Oil if they had known that the Product is impure and contaminated with a different oil or oils, and (b) they overpaid for the Product because it was sold at a price premium due to the representation.

**Fourth Cause of Action:**

## Breach of Express Warranty

(by Plaintiff and the Nationwide Class)

77. Plaintiff incorporates each and every factual allegation set forth above.

78. Plaintiff brings this cause of action individually and on behalf of herself and the Nationwide class. In the alternative, Plaintiff brings this claim on behalf of herself and members of the California Subclass.

79. Defendant, as the manufacturer, marketer, distributor, supplier, and/or seller of the Great Value Avocado Oil, issued material, written warranties by representing that the Products contain only “Avocado Oil.” These were affirmations of fact about the Products (i.e., that they contained only avocado oil) and a promise relating to the goods.

80. This warranty was part of the basis of the bargain and Plaintiff and class members relied on this warranty.

81. In fact, Great Value Avocado Oil does not conform to the above-referenced representation because, as alleged in detail above, Defendant's labeling is inaccurate and



1 the Products have been shown to be impure and contaminated with a different oil or oils.  
2 It is not pure avocado oil. Thus, the warranty was breached.

3 82. Plaintiff provided Defendant with notice of this breach of warranty, by  
4 mailing a notice letter to Defendant's headquarters, on September 20, 2024.

5 83. Plaintiff and the subclass were injured as a direct and proximate result of  
6 Defendant's conduct because: (a) they would not have purchased Great Value Avocado  
7 Oil if they had known that the Product is impure and contaminated with a different oil or  
8 oils, and (b) they overpaid for the Product because it was sold at a price premium due to  
9 the representation.

10 **Fifth Cause of Action:**

11 **Negligent Misrepresentation**

12 **(by Plaintiff and the California Subclass)**

13 84. Plaintiff incorporates each and every factual allegation set forth above.

14 85. Plaintiff brings this cause of action individually and on behalf of herself and  
15 the California Subclass.

16 86. As alleged more fully above, Defendant made false representations to  
17 Plaintiff and class members concerning its statements that the Products contain only  
18 avocado oil, and that they only contain avocado oil.

19 87. These representations were false.

20 88. When Defendant made these misrepresentations, it knew or should have  
21 known that they were false. Defendant had no reasonable grounds for believing that these  
22 representations were true when made.

23 89. Defendant intended that Plaintiff and class members rely on these  
24 representations, and Plaintiff and class members read and reasonably relied on them.

25 90. In addition, class-wide reliance can be inferred because Defendant's  
26 misrepresentations were material, i.e., a reasonable consumer would consider them  
27 important in deciding whether to buy the Great Value Avocado Oil.

91. Defendant's misrepresentations were a substantial factor and proximate cause in causing damages and losses to Plaintiff and class members.

92. Plaintiff and the subclass were injured as a direct and proximate result of Defendant's conduct because: (a) they would not have purchased Great Value Avocado Oil if they had known that the Product is impure and contaminated with a different oil or oils, and (b) they overpaid for the Product because it was sold at a price premium due to the representation.

**Sixth Cause of Action:**

**Intentional Misrepresentation**

**(by Plaintiff and the Nationwide Class)**

93. Plaintiff incorporates each and every factual allegation set forth above.

94. Plaintiff brings this cause of action individually and on behalf of herself and the Nationwide class. In the alternative, Plaintiff brings this claim on behalf of herself and members of the California Subclass.

95. As alleged more fully above, Defendant made false representations to Plaintiff and class members concerning its statements that the Products contained only avocado oil.

96. These representations were false.

97. When Defendant made these misrepresentations, it knew that they were false at the time that it made them and/or acted recklessly in making the misrepresentations.

98. Defendant intended that Plaintiff and class members rely on these representations, and Plaintiff and subclass members read and reasonably relied on them.

99. In addition, class-wide reliance can be inferred because Defendant's misrepresentations were material, i.e., a reasonable consumer would consider them important in deciding whether to buy the Great Value Avocado Oil.

100. Defendant's misrepresentations were a substantial factor and proximate cause in causing damages and losses to Plaintiff and class members.

101. Plaintiff and the subclass were injured as a direct and proximate result of Defendant's conduct because: (a) they would not have purchased Great Value Avocado Oil if they had known that the Product is impure and contaminated with a different oil or oils, and (b) they overpaid for the Product because it was sold at a price premium due to the representation.

**Seventh Cause of Action:**

**Quasi-Contract**

**(by Plaintiff and the Nationwide Class)**

102. Plaintiff incorporates each and every factual allegation set forth above.

103. Plaintiff brings this cause of action in the alternative to her Breach of Express Warranty claim (Count 5) on behalf of herself and the Nationwide Class. In the alternative, Plaintiff brings this claim on behalf of herself and members of the California Subclass.

104. As alleged in detail above, Defendant's false and misleading representations caused Plaintiff and the class to pay a price premium for the Products.

105. In this way, Defendant received a direct and unjust benefit, at the expense of Plaintiff and the class.

106. Plaintiff and the class seek the equitable return of this unjust benefit.

**VII. Relief.**

107. Plaintiff seeks the following relief for himself and the proposed class:

- An order certifying the asserted claims, or issues raised, as a class action;
- A judgment in favor of Plaintiff and the proposed class;
- Damages, treble damages, and punitive damages where applicable;
- Restitution;
- Rescission;
- Disgorgement, and other just equitable relief;
- Pre- and post-judgment interest;

- An injunction prohibiting Defendant's deceptive conduct, as allowed by law;
- Reasonable attorneys' fees and costs, as allowed by law;
- Any additional relief that the Court deems reasonable and just.

**VIII. Demand for Jury Trial.**

108. Plaintiff demands the right to a jury trial on all claims so triable.

Dated: December 30, 2024

Respectfully submitted,

By: /s/ Richard Lyon

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354327)

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*Attorneys for Plaintiff*

# **EXHIBIT C**

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*Attorney for Plaintiffs*

**UNITED STATES DISTRICT COURT  
CENTRAL DISTRICT OF CALIFORNIA**

EDIE GOLIKOV, individually and  
on behalf of all others similarly  
situated,

*Plaintiff,*

v.

WALMART INC.,

*Defendant.*

Case No. 2:24-cv-08211-RGK-MAR

**DECLARATION OF RICHARD  
LYON IN SUPPORT OF  
PLAINTIFF'S MOTION FOR CLASS  
CERTIFICATION**

Date: February 10, 2025

Time: 9:00 a.m.

Dept.: Courtroom 850

Assigned to the Hon. R. Gary Klausner

Complaint filed: September 24, 2024

**DECLARATION OF RICK LYON**

I, Richard Lyon, declare and state as follows:

1. I am a member in good standing of the bar of the state of California and a partner in the law firm of Dovel Luner LLP. I represent Plaintiff Edie Golikov in the above-referenced matter and am lead counsel for Ms. Golikov in this matter.

2. The following are true and accurate copies of listings for Walmart's cooking oil products from the Walmart website (www.walmart.com), accessed December 18, 2024:

Exhibit	Description	Price	Price Per Oz
1	Great Value Avocado Oil – 25.5 fl. oz	\$9.72	\$.381/oz
2	Great Value Vegetable Oil – 48 fl. oz	\$4.37	\$.091/oz

3. Attached as **Exhibit 3** is a true and correct copy of a scientific article published in the journal Food Control titled *Purity and quality of private labelled avocado oil*, accessible at <https://www.sciencedirect.com/science/article/pii/S0956713523002372>.

4. Attached as **Exhibit 4** is a true and correct copy of a scientific article published in the journal Food Control titled *First report on quality and purity evaluations of avocado oil in the US*, accessible at <https://www.sciencedirect.com/science/article/pii/S0956713520302449>.

5. Attached as **Exhibit 5** is a true and correct copy of an article published in the Washington Post titled *Why your avocado oil may be fake and contain other cheap oils*, accessible at <https://www.washingtonpost.com/wellness/2024/08/27/avocado-oil-adulteration-tests/>.

6. Attached as **Exhibit 6** is a true and correct copy of a Healthline article titled *Evidence-Based Health Benefits of Avocado Oil*, accessible at <https://www.healthline.com/nutrition/9-avocado-oil-benefits>.

7. Attached as **Exhibit 7** is a true and correct copy of a Chosen Foods article titled *Avocado Oil As A High Heat Cooking Oil*, accessible at



1 <https://chosenfoods.com/blogs/central/avocado-oil-as-a-high-heat-cooking->  
2 [oil?srsltid=AfmBOooJ6z-STY\\_FaexT2wMWae5Lr4ak-pEDYsAQPIVN20yvbhw9P1jV](https://chosenfoods.com/blogs/central/avocado-oil-as-a-high-heat-cooking-oil?srsltid=AfmBOooJ6z-STY_FaexT2wMWae5Lr4ak-pEDYsAQPIVN20yvbhw9P1jV).

3 8. Attached as **Exhibit 8** is a true and correct copy of a Healthline article titled  
4 *Canola Oil vs. Vegetable Oil: What's Healthiest?*, accessible at  
5 <https://www.healthline.com/health/food-nutrition/canola-vs-vegetable-oil>.

6 9. A true and correct copy of an image of the front of a bottle of Great Value  
7 Avocado Oil is attached as **Exhibit 9**. The front of Walmart's bottle prominently states  
8 "Avocado Oil," and includes images of avocados:



10. A true and correct copy of an image of the back of the Great Value Avocado Oil is attached as **Exhibit 10**. The back of the label lists only a single ingredient: Avocado Oil.



11. Dovel & Luner has been appointed lead counsel in multiple other cases and have successfully resolved—both through settlement and trial—consumer class actions. *See, e.g., Goodrich, et al. v. Alterra Mountain Co., et al.*, No. 1:20-cv-01057-RM-SKC (D. Colo.), Dkt. 157 (granting final approval of a \$17.5 million settlement in a consumer class action); *Barr et al. v. Select Blinds, LLC*, No. 2:22-cv-08326-SPG-PD (C.D. Cal.), Dkt. 56 (granting final approval of a \$10 million settlement in a consumer class action). For example, the Dovel lawyers were appointed co-lead counsel (among four competing groups) in a consumer protection class action in the District of Colorado. *Kramer v.*

1 *Alterra Mt. Co.*, 2020 U.S. Dist. LEXIS 135770, at \*8 (D. Colo.). The team was appointed  
2 for its “specific substantive investigation, research, and analysis already conducted to  
3 support and prosecute the claims on behalf of putative class members.” *Id.* at \*8.

4 12. Dovel & Luner was also appointed class counsel (or interim counsel) in  
5 *Damonie Earl et al. v. The Boeing Company*, No. 4:19-cv-00507 (E.D. Tex.) (a multi-billion-  
6 dollar RICO class action against Boeing and Southwest); and *In re: Arch Insurance Company*  
7 *Ski Pass Insurance Litigation*, MDL No. 2955 (W.D. Mo.) (an insurance coverage class  
8 action). Dovel & Luner serves on the leadership committee in *In re: Simulated Casino-Style*  
9 *Games Litigation*, No. 5:21-md-02985-EJD (N.D. Cal.) (a class action asserting that Apple,  
10 Google, and Facebook provide illegal social gambling applications).

11 13. Dovel also has the rare ability to try complex class actions to verdict. In  
12 April of 2019, Dovel lawyers obtained a \$925 million jury verdict in a TCPA class action  
13 pending in the District of Oregon. *Wakefield v. Visalus, Inc.*, No. 3:15-cv-1857- SI, 2020  
14 U.S. Dist. LEXIS 146959 (D. Or. Aug. 14, 2020).

15 14. Dovel & Luner has no conflicts with class members and is committed to  
16 vigorously prosecuting this case.

17 15. Dovel & Luner engaged Ceutical Labs to perform additional testing on a  
18 sample of Great Value Avocado Oil. A true and correct copy of the testing results are  
19 attached as **Exhibit 11**. Consistent with the UC Davis testing, these test results  
20 confirmed that the avocado oil was mixed with other cooking oils. The laboratory  
21 informed us that avocado oil does not have any C20 Fatty Acid, but the testing results  
22 show the presence of C20, C20.1, C20.2, and C20.3, which indicates the presence of other  
23 cooking oils.

24 I declare under penalty of perjury that the foregoing is true and correct. Executed  
25 this 8th day of January, 2025, at Los Angeles, California.

26  
27 Dated: January 8, 2025

/s/ Richard Lyon

Richard Lyon

# EXHIBIT 1



How do you want your items?  
Santa Monica, 90401 • Hawthorne N...

Search everything at Walmart online and in store

ID# 1267



Reorder  
My Items



Sign In  
Account

\$0.00

Departments Services | Holiday savings Grocery & Essentials Christmas Shop Gift Ideas Local Finds Toy Shop New & Trending Fashion Electronics Home Registry

Chobani. Tasty holidays start here The perfect recipe companion.

Sponsored ⓘ



Popular pick for "avocado oil great value"

Great Value

Great Value Refined Avocado Oil, 25.5 fl oz

★★★★☆ (4.2) | 304 ratings

Ingredients

About this item

Great Value Refined Avocado Oil, 25.5 fl oz:

- 25.5 fl oz bottle of refined avocado oil
- Mild flavor and a relatively high smoke point
- Use to saute, stir-fry or pan fry your favorite foods
- Add to homemade marinades or salad dressings
- About 50 servings per container



Tasty holidays start here

Make new recipe traditions with Chobani®.

Shop now

Chobani

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Fakespot Review Analysis



Analyze this product

\$9.72 38.1 c/fl oz

Price when purchased online ⓘ

Free 90-day returns

Add to cart



Subscribe

\$9.72

Your usuals, on your  
schedule  
Save time and stay  
stocked!  
[How it works](#)



One-time purchase

\$9.72

How do you want your item?



I want shipping & delivery savings with

Walmart+

You get 30 days free! Choose a plan at checkout.



Shipping  
Arrives Dec 20



Pickup  
Today



Delivery  
Today

New!

Pickup from Hawthorne Neighborhood Market

Aisle A10

Delivery to Santa Monica, 90401



Sold and shipped by Walmart.com



Free 90-day returns [Details](#)



This item is gift eligible [Learn more](#)



EBT eligible



Add to list



Add to registry



Sponsored

\$65.00

C60live - Carbon  
60 (Fullerene)...

3+ day shipping

+ Add

## Similar items you might like

Based on what customers bought



Best seller



Best seller



Best seller



Best seller





+ Add

Sponsored

**\$13.37** 26.2 ¢/fl oz

Olivari Grapeseed Oil, Cooking Oil for Frying & Sauteing, 51 fl oz

★★★★☆ 142

Save with W+

Pickup today  
Delivery today  
Shipping, arrives tomorrow

+ Add

Sponsored

**\$7.98** 15.6 ¢/fl oz

Iberia Premium Blend Sunflower Oil & Extra Virgin Olive Oil 51 fl oz

★★★★☆ 112

Save with W+

Pickup today  
Delivery today  
Shipping, arrives tomorrow

+ Add

**\$14.12** 55.6 ¢/fl oz

Chosen Foods 100% Pure Avocado Oil, 25.4 Floz Glass Bottle, Non-GMO

★★★★☆ 670

Save with W+

Pickup today  
Delivery today  
Shipping, arrives in 3+ days

+ Add

**\$19.48** 38.2 ¢/fl oz

Tropical Plantation 100% Pure Avocado Oil, 51 fl oz

★★★★☆ 148

Save with W+

Pickup today  
Delivery today  
Shipping, arrives tomorrow

## 4 stars and above

Based on customer ratings and number of reviews



+ Add

**\$11.48** 67.9 ¢/fl oz

Carapelli Organic Extra Virgin Olive Oil, 16.9 fl oz

★★★★☆ 156

EBT EBT eligible

1-day shipping



Best seller



+ Add

**\$7.22** 60.2 ¢/fl oz

Chosen Foods 100% Pure Avocado Oil-Based Classic Mayonnaise Jar, 12 fl oz

★★★★☆ 79

EBT EBT eligible

Pickup Delivery 1-day shipping



+ Add

**\$19.97** 78.3 ¢/fl oz

Partanna Organic Unfiltered Extra Virgin Olive Oil, 25.5 fl oz

★★★★☆ 44

EBT EBT eligible

1-day shipping



+ Add

**\$14.12** 55.6 ¢/fl oz

Chosen Foods 100% Pure Avocado Oil, 25.4 Floz Glass Bottle, Non-GMO

★★★★☆ 670

EBT EBT eligible

Pickup Delivery 3+ day shipping

Sponsored



C60live - Carbon 60 (Fullerene)...

3+ day shipping

+ Add

## More items to consider

Based on what customers bought



+ Add

Sponsored

**\$7.48** 42.5 ¢/oz

Morton Salt Himalayan Pink Salt, Fine - for Baking, Blending and More (17.6 oz)

★★★★☆ 346

Save with W+

Pickup today  
Delivery today  
Shipping, arrives tomorrow



Best seller



+ Add

+2 options

**\$5.63** ~~\$6.72~~ 32.0 ¢/oz

Great Value Fine Himalayan Pink Salt, 17.6 oz

★★★★☆ 48

Save with W+

Pickup today  
Delivery today  
Shipping, arrives tomorrow



+ Add

**\$6.86** 42.9 ¢/oz

Himalayan Chef Pink Salt 1lb Bag

★★★★☆ 119

Save with W+

Pickup today  
Delivery today  
Shipping, arrives tomorrow



Rollback



+ Add

**Now \$9.84** ~~\$16.98~~ 30.8 ¢/oz

Great Value Superfine Blanched Almond Flour, 2 lb

★★★★☆ 534

Save with W+

Pickup today  
Delivery today  
Shipping, arrives in 2 days

## About this item

Nutrition information

Product details

Enjoy the health benefits and versatility of Great Value Refined Avocado Oil. This 25.5 fluid ounce bottle with a screw top lid is ideal for keeping near your stovetop for use in all your recipes. Use this pure avocado oil to keep your stir-fries from sticking, to make a homemade salad dressing, or to drizzle on a Caprese salad. Substitute avocado oil for olive oil or vegetable oil in baking recipes. Avocado oil has a mild flavor and a relatively high smoke point, making it a great choice for cooking foods at high heat. Add it to a marinade for meats or brush vegetables with it to cook on the grill. Saute or pan fry your favorite dishes like chicken cutlets, dumplings, or fish. Make regular use of this shelf-stable and nutritious Great Value Refined Avocado Oil.

Great Value Refined Avocado Oil, 25.5 fl oz:

- 25.5 fl oz bottle of refined avocado oil
- Mild flavor and a relatively high smoke point
- Use to saute, stir-fry or pan fry your favorite foods
- Add to homemade marinades or salad dressings
- About 50 servings per container

We aim to show you accurate product information. Manufacturers, suppliers and others provide what you see here, and we have not verified it. [See our disclaimer](#)

Compare with similar items

Viewing this item

+ Add

\$9.72

Great Value Refined Avocado Oil, 25.5 f...

★★★★☆ 304

+ Add

\$14.12

Chosen Foods 100% Pure Avocado Oil...

★★★★★ 670

+ Add

\$19.48

Tropical Plantation 100% Pure Avocad...

★★★★★ 148

+ Add

\$5.37

Pompeian Grapeseed Oil - 24...

★★★★★ 317

+ Add

\$10.48

Spectrum Naturals Cold Pressed...

★★★★★ 10

Flavor	Unflavored	Unflavored	Unflavored	Grapeseed	Refined
Count	1	1	1	1	1
Nutrients	Trans Fat-Free	Kosher	Superfood	Corn-Free	Cold Pressed
Food preparation method	Refined	Refined	Cold Pressed	Filtered	Cold Pressed

See More

Specifications

- Container Material
- Plastic
- Cooking Oil Type
- Avocado Oils
- Third Party Accreditation Symbol on Product Package Code
- Kosher Certification Service
- Nutrient Content Claims
- Trans Fat-Free
- [More details](#)

Directions

**Safe Handling Instructions**  
OVERHEATED OILS MAY CAUSE FIRE. IF OIL SMOKES REDUCE HEAT. CAP WHEN NOT IN USE.

Ingredients

[Report incorrect product information](#)

Refine your search

- avocado oil spray

chosen foods avocado oil

organic avocado oil

avocado oil mayo

chosen avocado oil

avocado oil unrefined

avocado oil glass bottle

great value avocado oil

avocado oil mayonnaise

cold pressed avocado oil


Products you may also like

Best seller

Best seller

Sponsored






**\$5.76** 28.8 ¢/fl oz

Litehouse Creamy Avocado Ranch Refrigerated Salad Dressing, 20 Fluid oz Bottle

★★★★★ 2

EBT EBT eligible

Pickup Delivery




**\$2.88** 12.0 ¢/fl oz

WESSON Pure & Cholesterol Free Canola Oil, 24 fl oz

★★★★☆ 63

EBT EBT eligible

Pickup Delivery




**\$15.00** 93.8 ¢/fl oz

Spectrum Naturals Refined Walnut Oil, 16 fl oz

★★★★★ 160

3+ day shipping



**\$7.22** 60.2 ¢/fl oz

Chosen Foods 100% Pure Avocado Oil-Based Classic Mayonnaise Jar, 12 fl oz

★★★★★ 79

EBT EBT eligible

Pickup Delivery 1-day shipping

## Customer ratings &amp; reviews

4.2 out of 5

★★★★☆ 304 ratings | 129 reviews

How item rating is calculated ⓘ

[View all reviews](#)

All filters ▾

☆ Star rating ▾

Verified purchases only

Sort by | Most relevant ▾

Taste (23)

Price (21)

Value (10)

Bottle (9)

Cooking (9)

Quality (8)

Cap (6)

Package (5)

Design (4)

Baking (4)

Showing 1-3 of 129 reviews

Sep 12, 2023



★★★★★ Verified Purchase ⓘ

Ann

**WAY TO GO**

Avocado oil is by far the best tasting oil there is whether to fry or for salad dressing, this is the oil to buy, and is good for you too. This is a good far just like olive oil except it taste much better. In any case, the olive oil they sell in the US is not the best oil. We get the bottom of the barrel so to speak. The best olive oil stays...

[Read more](#)



Helpful?  (0)  (0) | [Report](#)

Nov 16, 2024

★★★★★ Verified Purchase ⓘ

Judy

i do like using this oil for cooking eggs, etc

Helpful?  (0)  (0) | [Report](#)

Dec 7, 2019



★★★★★

Jessica

**Healthy Choice**

This is my go to oil. Learning that only extra virgin olive oil is the healthy of the olive oils, and avocado I chose this one since I am sensitive to olives. I used to use grapeseed oil thinking that was healthy until I shared what I used with my children's pediatrician and she said that it wasnt good. Like most oils you dont...

[Read more](#)

Helpful?  (2)  (0) | [Report](#)

[View all reviews \(129\)](#)**Debit with rewards.** Get 3% cash back at Walmart, up to \$50 a year. See terms for eligibility. [Learn more.](#)**Chobani.**

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Customers also considered

Best seller

+ Add

\$7.94

46.7 ¢/fl oz

Great Value Extra Virgin Olive Oil, 17 fl oz

★★★★☆ 375

Save with W+

Pickup today  
Delivery today

Best seller

+ Add

\$12.16

72.0 ¢/fl oz

La Tourangelle Delicate Avocado Oil, 16.9 fl oz (500 ml)

★★★★☆ 62

Save with W+

Pickup today  
Delivery today  
Shipping, arrives tomorrow

Best seller

+ Add

\$9.28

58.0 ¢/fl oz

Pompeian Organic Robust Extra Virgin Olive Oil - 16 fl oz

★★★★☆ 144

Save with W+

Pickup today  
Delivery today  
Shipping, arrives tomorrow

Best seller

+ Add

\$7.84

16.3 ¢/fl oz

Great Value 48fo Gv Sunflower Oil

Save with W+

Shipping, arrives in 3+ days

Best seller

+ Add

\$5.98

42.7 ¢/fl oz

Great Value Organic Unrefined Virgin Coconut Oil, 14 fl oz

★★★★☆ 892

Save with W+

Pickup today  
Delivery today  
Shipping, arrives tomorrow

Best seller

+ Add

\$10.18

60.2 ¢/fl oz

Great Value California Extra Virgin Olive Oil, 16.9 fl oz

★★★★☆ 3

Save with W+

Pickup today  
Delivery today  
Shipping, arrives tomorrow

### More items to explore

Best seller

+ Add

\$14.12

55.6 ¢/fl oz

Chosen Foods 100% Pure Avocado Oil, 25.4 Floz Glass Bottle, Non-GMO

★★★★☆ 670

EBT EBT eligible

Pickup Delivery 3+ day shipping

Best seller

+ Add

\$2.88

12.0 ¢/fl oz

WESSON Pure & Cholesterol Free Canola Oil, 24 fl oz

★★★★☆ 63

EBT EBT eligible

Pickup Delivery

Best seller

+ Add

\$4.47

11.2 ¢/fl oz

Wesson Pure Canola Oil, 0g Trans Fat, Cholesterol Free, 40 fl oz

★★★★☆ 14

EBT EBT eligible

Pickup Delivery 1-day shipping

Best seller

+ Add

\$7.22

60.2 ¢/fl oz

Chosen Foods 100% Pure Avocado Oil-Based Classic Mayonnaise Jar, 12 fl oz

★★★★☆ 79

EBT EBT eligible

Pickup Delivery 1-day shipping

Best seller

+ Add

\$24.47

48.3 ¢/fl oz

Bertolli Olive Oil, Extra Light Taste, 50.7 fl oz

★★★★☆ 336

EBT EBT eligible

1-day shipping

Best seller

+ Add

\$19.97

78.3 ¢/fl oz

Partanna Organic Unfiltered Extra Virgin Olive Oil, 25.5 fl oz

★★★★☆ 44

EBT EBT eligible

1-day shipping

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### Products related to this item

Best seller

+ Add

\$19.94

Globetrotting Merchant Dish Towel, Lemon, Strawberry Avocado Fruits and...

2-day shipping

Best seller

+ Add

\$2.98

21.3 ¢/oz

La Famiglia DelGrosso, Sloppy Joe Sauce

★★★★☆ 41

EBT EBT eligible

1-day shipping

Best seller

+ Add

\$3.27

11.7 ¢/oz

La Victoria Traditional Red Enchilada Liquid Sauce Mild, 28 oz

★★★★☆ 131

EBT EBT eligible

Best seller

+ Add

\$11.99

Measuring Set Maroon 9pcs

★★★★☆ 10

2-day shipping

Best seller

+ Add

\$9.11

\$1.14/fl oz

Primal Kitchen Italian Vinaigrette & Marinade 8 fl oz

★★★★☆ 798

3+ day shipping

Best seller

+ Add

\$3.48

23.2 ¢/oz

LA VICTORIA Mild Red Taco Sauce Liquid, Shelf-Stable, 15 oz Plastic Bottle

★★★★☆ 250

EBT EBT eligible

## Related pages

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[Vegetable Oil Make](#)

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[Corn oils](#)

[Vegetable O](#)

[Baking Avocado Oil](#)

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[5 Gallon Vegetable Oil](#)

[Admiration Foods](#)

[Olive oil](#)

# EXHIBIT 2



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Nutrition Facts	
Total Fat	10g
Sodium	100mg
Total Carbohydrate	10g
Total Sugars	10g
Total Protein	10g

INGREDIENTS: SOYBEAN OIL



Best seller Popular pick for "vegetable oil"

Great Value

Great Value Vegetable Oil, 48 fl oz

★★★★☆ (4.2) | 1,945 ratings

Ingredients

About this item

- Great Value Vegetable Oil, 48 fl oz
- Great for frying, baking, and making salad dressings
- Good for high-heat cooking
- Neutral flavor
- Essential pantry staple
- Contains 96 servings



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Fakespot Review Analysis

Reanalyze this product

\$4.37 9.1 ¢/fl oz

Price when purchased online ⓘ

Free 90-day returns

Add to cart

Subscribe \$4.37

Your usuals, on your schedule  
Save time and stay stocked!  
[How it works](#)

One-time purchase \$4.37

How do you want your item?

☐ I want shipping & delivery savings with

Walmart+

You get 30 days free! Choose a plan at checkout.

Shipping  
Out of stock

Pickup  
Today

Delivery  
Today

New!

Pickup from Hawthorne Neighborhood Market

Aisle A10

Delivery to Santa Monica, 90401

EBT EBT eligible

Add to list

Add to registry



Sponsored

\$22.94

90.0 ¢/fl oz

Atlas Organic Extra Virgin Olive Oil...

★★★★☆ 26

3+ day shipping

+ Add

Similar items you might like

Based on what customers bought



+ Add

Sponsored



Best seller



+ Add



Best seller



+ Add



+ Add



Add to cart

How do you want your item?

☐ I want shipping & delivery savings with

Walmart+

You get 30 days free! Choose a plan at checkout.

Shipping  
Out of stock

Pickup  
Today

Delivery  
Today

New!

Pickup from Hawthorne Neighborhood Market

**\$12.28** 9.6 ¢/fl oz

Wesson Pure &amp; Cholesterol Free Soybean Vegetable Oil, 128 fl oz

★★★★☆ 168

Save with W+

Pickup today  
Delivery today  
Shipping, arrives tomorrow**\$4.47** 11.2 ¢/fl oz

Wesson Pure &amp; Cholesterol Free Soybean Vegetable Oil, 40 fl oz

★★★★☆ 15

Save with W+

Pickup today  
Delivery today  
Shipping, arrives tomorrow**\$7.94** 46.7 ¢/fl oz

Great Value Extra Virgin Olive Oil, 17 fl oz

★★★★☆ 375

Save with W+

Pickup today  
Delivery today**\$7.84** 16.3 ¢/fl oz

Great Value 48fo Gv Sunflower Oil

Save with W+

Shipping, arrives in 3+ days

Aisle A10

Delivery to **Santa Monica, 90401**

## 4 stars and above

Based on customer ratings and number of reviews

Sponsored



+ Add

**\$15.48** 45.5 ¢/fl oz

Terra Delyssa Organic Extra Virgin Olive Oil, 34 fl. oz. Glass

★★★★☆ 414

EBT EBT eligible

3+ day shipping



+ Add

**\$24.47** 48.3 ¢/fl oz

Bertolli Cooking Olive Oil, 50.7 fl oz

★★★★☆ 171

EBT EBT eligible

1-day shipping



+ Add

**\$12.28** 9.6 ¢/fl oz

Wesson Pure &amp; Cholesterol Free Soybean Vegetable Oil, 128 fl oz

★★★★☆ 168

EBT EBT eligible

Pickup Delivery 1-day shipping



+ Add

**\$24.47** 48.3 ¢/fl oz

Bertolli Olive Oil, Extra Light Taste, 50.7 fl oz

★★★★☆ 336

EBT EBT eligible

1-day shipping

## More items to consider

Based on what customers bought



Best seller



+ Add

**\$2.52** 31.5 ¢/oz

Great Value Original Cooking Spray, 8 ounces

★★★★☆ 736

Save with W+

Pickup today  
Delivery today

Best seller



+ Add

Sponsored

**\$4.47** 11.2 ¢/fl oz

Wesson Pure &amp; Cholesterol Free Soybean Vegetable Oil, 40 fl oz

★★★★☆ 15

Save with W+

Pickup today  
Delivery today  
Shipping, arrives tomorrow

+ Add

+2 options

**\$6.48** 13.5 ¢/oz

Great Value All Vegetable Shortening, 48 oz Can

★★★★☆ 233

Save with W+

Pickup today  
Delivery today

Best seller



+ Add

+2 options

**\$0.62** 2.4 ¢/oz

Great Value Iodized Salt, 26 oz

★★★★☆ 1174

Save with W+

Pickup today  
Delivery today

## About this item

Nutrition information




Product details



Great Value Vegetable Oil is the perfect choice for all of your cooking needs. The 48-ounce bottle contains 96 servings with only 120 calories and two grams of saturated fat per serving. Plus, the value size bottle is only a fraction of the cost of name brand vegetable oils. This versatile cooking oil contains only soybean oil with no preservatives. It is also gluten free and Kosher certified. With a higher smoke point than other oils, vegetable oil is great for frying and baking. You can also use this oil as a blank canvas for yummy salad dressings. Oil made from soybeans is rich in fatty acids, antioxidants, and essential vitamins and minerals. Regardless of what you're cooking, you can be certain you're making a healthy choice when you use Great Value Vegetable Oil.


Great Value products provide families with affordable, high quality grocery and household consumable options. With our wide range of product categories spanning grocery and household consumables, we offer you a variety of products for your family's needs. Our products are conveniently available online and in Walmart stores nationwide, allowing you to stock up and save

- Great Value Vegetable Oil, 48 fl oz
- Great for frying, baking, and making salad dressings
- Good for high-heat cooking
- Neutral flavor
- Essential pantry staple
- Contains 96 servings

 We aim to show you accurate product information. Manufacturers, suppliers and others provide what you see here, and we have not verified it. [See our disclaimer](#)

Compare with similar items

Viewing this item




+ Add

\$4.37

Great Value Vegetable Oil, 48 f...

★★★★☆ 1946




+ Add

\$12.28

Wesson Pure & Cholesterol Free...

★★★★☆ 168




+ Add

\$4.47

Wesson Pure & Cholesterol Free...

★★★★☆ 15




+ Add

\$7.94

Great Value Extra Virgin Olive Oil, 17 ...

★★★★☆ 375



+ Add

\$14.32

(4 pack) 1-2-3 Vegetable Oil, 33.8...

★★★★☆ 55

Flavor	Unflavored	Unflavored	Unflavored	Unflavored	Unflavored
Count	1	1	1	1	1
Dietary method	Vegan	Vegan	Kosher	Vegetarian	Kosher
Allergen-free statements	Gluten-Free	Gluten-Free	Gluten-Free	Gluten-Free	Dairy-Free

See More

Specifications

Container Material

Plastic

Features

No trans fat, 100% pure, No artificial flavors or colors

Cooking Oil Type

Vegetable Oils

Third Party Accreditation Symbol on Product Package Code

Kosher Certification Service

[More details](#)

Directions

Instructions

Store at room temperature.

Safe Handling Instructions

CAUTION: ANY OIL WILL BURN IF OVERHEATED. DO NOT LEAVE UNATTENDED WHILE HEATING. IF OIL SMOKES, REDUCE HEAT. IF FIRE OCCURS, TURN OFF HEAT AND COVER UNTIL COOL. DO NOT PUT WATER ON HOT OR FLAMING OIL. DO NOT POUR HOT OIL INTO THIS CONTAINER AS DAMAGE MAY OCCUR, CAUSING INJURY.

Ingredients

Warnings

Warning Text

CAUTION: ANY OIL WILL BURN IF OVERHEAD. DO NOT LEAVE UNATTENDED WHILE HEATING. IF OIL SMOKES, REDUCE HEAT. IF FIRE OCCURS, TURN OFF HEAT AND COVER UNTIL COOL. DO NOT PUT WATER ON HOT OR FLAMING OIL. DO NOT POUR HOT OIL INTO THIS CONTAINER. DAMAGE CAN OCCUR, CAUSING INJURY.

 [Report incorrect product information](#)

Refine your search

great value olive oil

great value coconut oil

great value oil canola

great value peanut oil

great value sunflower oil

great value oil spray


great value oil grapeseed

great value oil small

great value vegetable oil


great value oil scented






+ Add

**\$4.47** 11.2 ¢/fl oz  
Wesson Pure & Cholesterol Free Soybean Vegetable Oil, 40 fl oz  
★★★★☆ 15  
EBT EBT eligible  
Pickup Delivery 1-day shipping




+ Add

**\$12.28** 9.6 ¢/fl oz  
Wesson Pure & Cholesterol Free Soybean Vegetable Oil, 128 fl oz  
★★★★☆ 168  
EBT EBT eligible  
Pickup Delivery 1-day shipping



+ Add

**\$2.88** 12.0 ¢/fl oz  
WESSON Pure & Cholesterol Free Canola Oil, 24 fl oz  
★★★★☆ 63  
EBT EBT eligible  
Pickup Delivery



+ Add

**\$4.47** 11.2 ¢/fl oz  
Wesson Pure Canola Oil, 0g Trans Fat, Cholesterol Free, 40 fl oz  
★★★★☆ 14  
EBT EBT eligible  
Pickup Delivery 1-day shipping

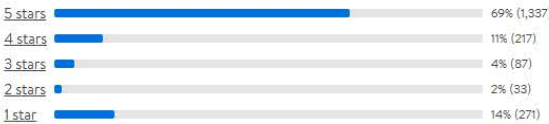
Customer ratings & reviews

4.2 out of 5

★★★★☆ 1,945 ratings | 774 reviews

How item rating is calculated ⓘ

View all reviews



All filters ▾

★ Star rating ▾

Verified purchases only

Sort by | Most relevant ▾

Price (161)

Value (78)

Quality (35)

Taste (33)

Cooking (29)

Frying (27)

Oil (23)

Baking (13)

Size (10)

Salads (8)

Showing 1-3 of 774 reviews

Jun 8, 2024

★★★★★ Verified Purchase ⓘ

Ethel

**Great Job!**  
Kressee did a great, great job fetting everything in order, including t g e substitutions. The only thing I would caution her on is ....she left the groceries at the wrong door. Left at groceriers at 506 and my apartment is 504. Luckily I have Great neighboros abd not anything was bothered. Otherwise, sge did a...  
[Read more](#)

Helpful?  (0)  (0) | [Report](#)

Jun 12, 2024

★★★★★ Verified Purchase ⓘ

Marsha

**Nice guy.**  
What a nice guy the delivery man was. He was very accommodating, as he came in and put the groceries on the kitchen table for me. I really appreciated him for that extra step.

Helpful?  (0)  (0) | [Report](#)

Feb 16, 2024

★★★★★ Verified Purchase ⓘ

Marilyn

**shoppers guide**  
I'm loving shopping for groceries online it saves me the hassle or going to the grocery store standing in long lines and crowds If they get something wrong with your order they will gladly refund your order money back lines and crowds If they get something wrong with your order they will gladly refund your order money back on your card also replacement it next day and if there not in stock what you asking for by shipping it to you...  
[Read more](#)

Helpful?  (0)  (0) | [Report](#)

View all reviews (774)



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## Customers also considered

 <b>+ Add</b>	 <b>+ Add</b>	 <b>+ Add</b>	 <b>+ Add</b>	 <b>+ Add</b>	 <b>Options</b>
<small>Sponsored</small> <b>\$4.47</b> 11.2 ¢/fl oz Wesson Pure Canola Oil, 0g Trans Fat, Cholesterol Free, 40 fl oz ★★★★☆ 14 <a href="#">Save with W+</a> Pickup today Delivery today Shipping, arrives tomorrow	<small>Sponsored</small> <b>\$7.63</b> 47.7 ¢/fl oz Pompeian Mild Taste Olive Oil - 16 fl oz ★★★★☆ 106 <a href="#">Save with W+</a> Pickup today Delivery today Shipping, arrives in 3+ days	<b>\$17.16</b> 13.4 ¢/fl oz Great Value Peanut Oil, 1 gal ★★★★☆ 374 <a href="#">Save with W+</a> Pickup today Delivery today Shipping, arrives tomorrow	<b>\$5.37</b> 22.4 ¢/fl oz Pompeian Grapeseed Oil - 24 fl oz ★★★★☆ 317 <a href="#">Save with W+</a> Pickup today Delivery today Shipping, arrives tomorrow	<b>\$5.28</b> 13.2 ¢/fl oz Mazola Canola Oil, 40 fl oz ★★★★☆ 10 <a href="#">Save with W+</a> Pickup today Delivery today Shipping, arrives in 3+ days	<small>+2 options</small> <b>Now \$18.36</b> <del>\$27.89</del> 1-2-3 Vegetable Oil 16.9 fl oz (Pack of 5) Shipping, arrives in 3+ days

## More items to explore

 <b>+ Add</b>	 <b>+ Add</b>	 <b>+ Add</b>	 <b>+ Add</b>	 <b>+ Add</b>	 <b>+ Add</b>
<b>\$24.47</b> 48.3 ¢/fl oz Bertolli Olive Oil, Extra Light Taste, 50.7 fl oz ★★★★☆ 336 <a href="#">EBT</a> EBT eligible 1-day shipping	<b>\$12.47</b> 49.1 ¢/fl oz Bertolli Cooking Olive Oil, 25.4 fl oz ★★★★☆ 178 <a href="#">EBT</a> EBT eligible 1-day shipping	<b>\$4.47</b> 11.2 ¢/fl oz Wesson Pure & Cholesterol Free Soybean Vegetable Oil, 40 fl oz ★★★★☆ 15 <a href="#">EBT</a> EBT eligible Pickup Delivery 1-day shipping	<b>\$24.47</b> 48.3 ¢/fl oz Bertolli Cooking Olive Oil, 50.7 fl oz ★★★★☆ 171 <a href="#">EBT</a> EBT eligible 1-day shipping	<b>\$12.28</b> 9.6 ¢/fl oz Wesson Pure & Cholesterol Free Soybean Vegetable Oil, 128 fl oz ★★★★☆ 168 <a href="#">EBT</a> EBT eligible Pickup Delivery 1-day shipping	<b>\$2.88</b> 12.0 ¢/fl oz WESSON Pure & Cholesterol Free Canola Oil, 24 fl oz ★★★★☆ 63 <a href="#">EBT</a> EBT eligible Pickup Delivery

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## Products related to this item

 <b>+ Add</b>	 <b>+ Add</b>	 <b>+ Add</b>	 <b>+ Add</b>	 <b>+ Add</b>	 <b>+ Add</b>
--	---	---	--	---	---

Now \$24.99 ~~\$29.99~~

Regia 10-inch Skillet - Tri-ply  
Stainless Steel Pan

3+ day shipping

\$13.99

Native Fab 4 Pack Gingham  
Check Plaid Kitchen Towel -  
Soft Cotton - Washcloths - ...

2-day shipping

\$19.98

FE FUN ELEMENTS Bamboo  
Large Capacity 3-  
Compartment Kitchen...

★★★★☆ 7

2-day shipping

~~\$22.99~~

Native Fab 12 Pack Gingham  
Check Plaid Kitchen Towel -  
Soft Cotton - Washcloths - ...

2-day shipping

\$29.99

BENTISM Pan and Pot Rack  
Organizer Expandable  
Adjustable Lid Holder Under...

★★★★★ 1

3+ day shipping

Now \$27.88 ~~\$33.67~~

Martha Stewart Everyday  
Charlemont Teal 4.5-Quart  
Enamel Aluminum Saute Pa...

★★★★★ 79

3+ day shipping

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# EXHIBIT 3



Contents lists available at ScienceDirect

## Food Control

journal homepage: [www.elsevier.com/locate/foodcont](http://www.elsevier.com/locate/foodcont)

## Purity and quality of private labelled avocado oil

Hilary S. Green, Selina C. Wang<sup>\*</sup>

Department of Food Science and Technology, University of California Davis, Davis, CA, 95616, USA

## ARTICLE INFO

## Keywords:

Avocado oil  
Purity  
Quality  
Adulteration  
Standards  
Private label

## ABSTRACT

Avocado oil continues to be a high demand product and there is a growing market for both name brands and private labels. Since our study on evaluating the purity and quality of name brand avocado oil in 2020, some producers have made efforts to assure quality and lend support for standard establishment. However, the purity and quality of private labeled avocado oil have not been evaluated and are of a concern for many consumers. This study evaluates thirty-six private label samples throughout the US and Canada. Out of 29 refined samples, three met both quality and purity standards, 11 met quality standards and eight met current proposed purity standards; out of 7 unrefined samples, three met current proposed purity standards for avocado oil. Key markers such as an elevated stearic fatty acid value with an elevated delta-7-stigmastenol value were identified to help professional buyers make educated decisions on what oils to purchase. Low cost can indicate a higher probability for adulteration; however, high cost does not guarantee a pure sample of appropriate quality. Both purity and quality parameters should be used to label the avocado oil appropriately to ease consumer confusion and increase their confidence in the avocado oil category. This work also highlighted the importance of continuing to research avocado oil, to understand natural variables that affect chemical compositions of avocado oil and to establish standards that accommodate these variances while minimizing adulterations.

## 1. Introduction

Avocado oil is in high demand by consumers because of its high content of monounsaturated fatty acids, much like olive oil, as well as having a neutral flavor profile (Woolf et al., 2009). Thus, the avocado oil industry has continued to expand over the last five years. Due to the continued rise in avocado oil popularity, it is now being sold as a product by many grocery stores under private label brands in addition to name brand products. Private label oils are products that are produced by a third-party processor (or brand) and sold under a certain grocery store label (or brand). This process may lead to more adulteration and fraud due to the increased number of steps and parties involved; if the fruit is processed into oil in one place, refined in another location, and labeled/bottled in a third place, adulteration has the potential to occur at any of those steps and some parties, like the professional buyer can be unaware when malpractices are taking place (Ehmke et al., 2019). It is not only necessary for these oils to be tested by third parties, but also for professional buyers to know what a pure avocado oil should look like in the Certificate of Analysis so that they can make the right choices in what oils to sell under their private label. Although product quality and traceability are important evaluation criteria of suppliers for private

label buyers, pricing is the decisive factor for most buyers. It costs more to make 100% authentic avocado oil than 100% soybean oil or a mix of 50% avocado oil and 50% high oleic sunflower oil so fraudulent suppliers could sell their products at a lower price than honest authentic avocado oil suppliers and still make more profit.

The formation of avocado oil standards by the international standard development organization, CODEX Alimentarius, formed by the World Health Organization (WHO) and Food and Agriculture Association (FAO), is well underway (Codex Alimentarius Commission, 2021a), however, this process takes time and the standards for refined avocado oil are still being finalized while a separate set of standards for virgin/extra virgin will likely need to be further developed. Due to avocado oil being a relatively new product, it is difficult with the current information available for professional buyers to make the right decisions on what to purchase. To address some of these issues, an evaluation of thirty-six private label oils currently on the market was done to determine their quality and purity and how they relate to proposed CODEX standards and pure samples in literature. This work also serves as a follow-up to our 2020 study on the evaluation of quality and purity of avocado oils in the US as we received many inquiries from consumers about private label oils, which were not the focus in the original study

<sup>\*</sup> Corresponding author..E-mail address: [scwang@ucdavis.edu](mailto:scwang@ucdavis.edu) (S.C. Wang).<https://doi.org/10.1016/j.foodcont.2023.109837>

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(Green & Wang, 2020). These private label oils were used to identify set of common markers of adulteration to help professional buyers to determine what oils to purchase. This includes a list of fatty acids and sterols and how increases or decreases in specific values can help buyers determine if there is adulteration occurring and if so, potentially with what oil. Techniques to assess oil quality were also discussed as well as issues with current labeling, which currently contains many contradictions. With this information, professional buyers can be more confident in choosing products that are pure and of good quality.

## 2. Materials and methods

### 2.1. Avocado oil samples

A total of 36 private label oils, which are oils bought from a third-party manufacturer but are sold under a retailer brand, were purchased from grocery stores across the US and Canada. Samples labeled as both refined (29) and virgin/extra virgin samples (7) were collected. If a sample did not have a specific label or had ambiguous labeling, like refined and cold-pressed or pure and cold-pressed, it was assumed to be refined. Each oil sample was stored in the dark at 20 °C and purged with nitrogen after each opening. Quality analyses were completed first upon opening to minimize changes in oil quality due to oxygen exposure. Table 1 contains information about each sample including their designated grade (refined vs. virgin/extra virgin), product origin, purchasing location, packaging, price and best by date. Samples were numbered and data organized according to sample label, with one group for refined oils and another for virgin/extra virgin. Table S1 contains a list of the private label brands that were analyzed in this study, in alphabetical order.

**Table 1**  
Information for each sample used in this study.

Code	Oil Label	Product origin	Place purchased	Packaging	Price/Oz (\$)	Best by date
1	Refined	Mexico	RI	Colored plastic	0.29	3/24/2022
2	Refined	Mexico	IA	Colored plastic	0.29	3/8/2022
3	Refined	Spain	BC, Canada	Colored glass	0.33	8/18/2022
4	Refined	USA, Mexico	IL	Colored glass	1.18	1/2/2022
5	Refined	USA, Mexico	NC	Colored glass	1.06	4/29/2022
6	Refined	Mexico, South Africa, France	TX	Colored glass	0.41	5/17/2022
7	Refined	Mexico, South Africa, France	CO	Colored glass	0.47	5/17/2022
8	Refined & expeller pressed	France	IL	Colored glass	0.53	3/1/2023
9	Refined & expeller pressed	France	RI	Colored glass	0.53	3/1/2023
10	Refined & expeller pressed	Mexico	RI	Clear glass	0.71	4/13/2023
11	Refined & expeller pressed	South Africa	CO	Clear glass	0.71	3/8/2023
12	Refined & expeller pressed	South Africa	CA	Clear glass	0.71	3/8/2023
13	Refined & expeller pressed	Mexico	CA	Clear glass	0.70	12/7/2022
14	Refined & expeller pressed	Mexico	MA	Colored glass	0.61	4/30/2022
15	Cold pressed & Refined	Spain	IL	Colored glass	0.42	10/1/2022
16	Cold pressed & Refined	Spain	MN	Colored glass	0.53	Unclear
17	Cold pressed & Refined	Mexico, Spain, USA	IL	Colored glass	0.50	9/25/2022
18	Cold pressed & Refined	Mexico, Spain, USA	IL	Colored plastic	0.50	9/1/2022
19	Unspecified	Mexico	BC, Canada	Colored glass	0.44	7/5/2022
20	Unspecified	Mexico	KS	Colored glass	0.59	2/25/2023
21	Unspecified	Mexico	MN	Colored glass	0.59	2/25/2023
22	Unspecified	Mexico	NC	Colored glass	0.55	12/31/2023
23	Unspecified	Mexico	IL	Colored glass	0.55	3/2/2023
24	Unspecified	Mexico	CA	Colored glass	0.47	3/25/2023
25	Unspecified	Mexico	RI	Colored glass	0.47	12/31/2021
26	Cold pressed	Spain	DC	Colored plastic	0.39	4/29/2023
27	Cold pressed	Mexico, Spain, USA	NC	Colored glass	0.24	2/28/2023
28	Cold pressed	Mexico, Spain, USA	IL	Colored glass	0.41	3/26/2023
29	Cold pressed	Mexico, Spain, USA	NC	Colored glass	0.29	10/23/2022
30	Virgin/Extra virgin	Mexico	ON, Canada	Colored glass	0.45	7/30/2022
31	Extra Virgin	Mexico	BC, Canada	Colored glass	0.54	8/31/2022
32	Extra virgin	Spain	RI	Colored glass	0.83	5/25/2023
33	Extra virgin	Spain	NJ	Colored glass	0.83	3/9/2023
34	Virgin	Mexico	RI	Clear glass	0.71	3/1/2023
35	Virgin	Mexico	CA	Clear glass	0.71	2/26/2023
36	Extra virgin	Mexico	NJ	Colored glass	0.83	4/30/2022

### 2.2. Quality parameters

Free fatty acidity (FFA), peroxide value (PV), and specific extinction in ultraviolet (UV) at 232 nm, 270 nm, and  $\Delta K$  were determined using AOCS methods Ca 5a-40 (09), Cd 8b-90 (09), and Ch 5-91 (09) ((American Oil Chemist's Society, 1998)), respectively.

### 2.3. Minor components

Tocopherols were determined according to Gimeno et al. (2000) with some modifications. Oil (40  $\mu$ L) and hexane (160  $\mu$ L) were briefly vortexed then the internal standard ( $\alpha$ -tocopheryl acetate, 300  $\mu$ g/mL in ethanol, purity 98%, Fisher Scientific Company LLC, USA) was added along with 600  $\mu$ L of methanol. The mixture was vortexed for 1 min and centrifuged for 5 min (5000 rpm, Beckman GS-15 R). Samples were stored at -20 °C for 2 h to allow oil to fully separate from the organic phase, which was then filtered with 0.45  $\mu$ m, nylon syringe filters. Analysis was performed on an Agilent 1290 Infinity II LC system with a diode-array detector using an Agilent ZORBAX Eclipse Plus C18 column (3.5  $\mu$ m, 3  $\times$  100 mm) with a methanol:water (96:4) isocratic mobile phase. A 20  $\mu$ L injection volume and flow rate of 1.0 mL min<sup>-1</sup> were used giving a total run time was 12 min. Diode-array detector (DAD) signal was recorded at 292 nm. All solvents used above were HPLC grade, from Fisher Scientific LLC, USA. Standard  $\alpha$ -tocopherol (>96%) was purchased from Fisher Scientific LLC, USA. Analytical grade standards  $\delta$ -tocopherol and  $\gamma$ -tocopherol were purchased from MilliporeSigma, USA. Gamma and beta tocopherols were quantified together.

### 2.4. Purity parameters

The IOC official method for the determination of the fatty acid

methyl esters by gas chromatography (COI/T.20/Doc. No 30/Rev.1, 2017) was used for fatty acid profile analysis with modifications. Approximately 20  $\mu\text{L}$  of oil was mixed with 3 mL heptane. Methanolic KOH, 2 M was added (200  $\mu\text{L}$ ) and vortexed for 1 min. Once the organic phase was clear, it was filtered with 0.45  $\mu\text{m}$  PTFE filter for analysis. The GC-FID analysis was performed on an Agilent 7890 A GC using a 90 m  $\times$  250  $\mu\text{m}$   $\times$  0.25  $\mu\text{m}$  DB-FastFAME capillary column (Agilent Technologies) to achieve the separation of individual fatty acids. Helium was used as the carrier gas at a flow rate of 1.9 mL min<sup>-1</sup> with an injection volume of 1.0  $\mu\text{L}$  and a split ratio of 30. The injector temperature was held at 260 °C. The GC oven program was held at 75 °C for 1 min; then ramped at 35 °C min<sup>-1</sup> to 200 °C and held for 14 min, followed by a ramp of at 2.5 °C min<sup>-1</sup> to 210 °C, which was held for 5 min. The last ramp was at 12 °C min<sup>-1</sup> to 230 °C and held for 20 min, giving a total run time of 49.2 min. The FID temperature was 260 °C. The detector gas consisted of hydrogen (flow rate: 40 mL min<sup>-1</sup>), air (flow rate: 400 mL min<sup>-1</sup>), and helium make up gas (flow rate: 25 mL min<sup>-1</sup>). Peak identification was performed using a 37-component FAME reference standard mix (MilliporeSigma).

Sterols content was analyzed using a combination of both Mathison and Holstege (2013) and the Phenomenex determination of sterols in olive oil (TN-0114) with modifications, which is described in more detail in Green and Wang (2023a). First, 20  $\mu\text{L}$  of internal standard 0.2%  $\alpha$ -cholestanol ethyl acetate solution was dried before adding 200 mg of oil and 1.5 mL of 2 M KOH in 95% ethanol. The mixture was capped and heated at 80 °C in two, 25 min increments. Once removed from the heat, 13.5 mL DI water was added and gently mixed before loading onto a Phenomenex Strata DE SLE cartridge, 60 cc tube, followed by two 1 mL rinses with DI water. A syringe packed with glass wool and 6–7 g sodium sulfate was attached to the bottom of the cartridge and after 15 min, five 15 mL portions of diethyl ether were passed through the cartridge. Eluents were dried using a rotary evaporator and then placed in an oven at 100 °C to remove water before reconstituting with 5 mL hexane. Next, the silica SPE columns (6 mL, 1 g sorbent, Agilent brand) were conditioned using two, 6 mL hexane rinses followed by 1 mL of 0.2 M KOH in 98% ethanol, followed by an additional 5 mL hexane rinse. Samples were loaded onto the columns and washed with 85 mL of hexane: diethyl ether (98:2) at 2 mL min<sup>-1</sup>. The sterols fraction was eluted using 5 mL of hexane: diethyl ether (80:20) followed by 5 mL of hexane: diethyl ether (60:40). Extracts were dried in a rotary evaporator and if needed placed in an oven at 100 °C to remove remaining water. Finally, 250  $\mu\text{L}$  of the silylation reagent (pyridine/hexamethyl disilazane/trimethylchlorosilane, 9:3:1, v/v/v) was added to prepare the trimethylsilyl ethers for GC injection. The GC-FID analysis was conducted on an Agilent 7890 A GC with a 30 m  $\times$  0.25 mm  $\times$  0.25  $\mu\text{m}$  DB-5 capillary column (Agilent Technologies). An injection volume of 1.0  $\mu\text{L}$  and helium as the carrier gas at a flow rate of 1.2 mL min<sup>-1</sup> was used. The injector temperature was held at 280 °C at a split ratio of 5. The GC oven program was held isothermally at 150 °C for 8 min; then ramped at 20 °C min<sup>-1</sup> to 290 °C and held for 20 min to obtain a total run time of 37.33 min. The FID temperature was 300 °C. The detector gas consisted of hydrogen (flow rate: 30 mL min<sup>-1</sup>), air (flow rate: 400 mL min<sup>-1</sup>), and helium make up gas (flow rate: 25 mL min<sup>-1</sup>). Peak identification was carried out with standards and sample chromatograms provided in the IOC official method for relative retention times. Quantification was performed using the peak area and concentration of the internal standard.

Triacylglycerols (TAGs) were separated and analyzed using the method described in Green et al. (2020). In brief, each oil was diluted to a final concentrate of 1% with 50/50 chloroform/MeOH and then analyzed with the Vanquish™ Flex UHPLC-CAD system (Thermo Fisher Scientific, Waltham, MA, USA). Analytes were separated on a Thermo Scientific™ Accucore™ C18 column (100 mm  $\times$  2.1 mm; 2.6  $\mu\text{m}$ ). The injection volume was 1  $\mu\text{L}$  with a 0.5 mL min<sup>-1</sup> flow rate. Mobile phase A (acetonitrile) and mobile phase B (isopropanol) were used according to the following gradient conditions: start, 10% B; 2 min, 10% B; 25 min,

40% B; 30 min, 60% B; 35 min, 90% B; 40 min, 50% B and 45 min 10% B. All solvents were HPLC grade from Fisher Scientific LLC, USA.

### 2.5. Statistical analysis

In all figures and tables the error bars represent the standard deviation. Principal component analysis was completed using Originlab Corporation software version “OriginPro 2016 Sr2” using TAGs as variables and 95% confidence ellipses around each PCA cluster.

## 3. Results and discussion

### 3.1. Purity parameters

#### 3.1.1. Fatty acid profile

Fatty acid profile is currently the most widely used purity determination method for edible oils. Table 2 shows the results of the fatty acid profile for the samples in this study. There were nine refined oils and three extra virgin oils that passed the current proposed CODEX purity standards, giving a total of 33% of the total samples to pass the fatty acid profile results. For most of the samples that failed, they failed on multiple different fatty acids, increasing the possibility that economically motivated adulteration (EMA) is the reason the profiles did not match the proposed avocado oil standards. Some trends within these failures can be seen, an elevated stearic fatty acid (C18:0) content is accompanied by a low palmitoleic fatty acid (C16:1) content. Most common adulterant oils, including high oleic sunflower oil, high oleic safflower oil, canola oil, and soybean oil have lower palmitoleic and higher stearic fatty acid content compared to avocado, so these can be used as potential adulteration markers. It is also more common for the palmitic (C16:0) fatty acid to be too low rather than too high if adulteration is occurring. These same trends were seen in the original 2020 study on avocado oils available in the US; a sample was most likely to fail stearic fatty acid (too high), which was often accompanied with a palmitoleic fatty acid that was too low (Green & Wang, 2020). Although avocado oil is characterized as having a high oleic fatty acid content, the range for oleic fatty acid is so wide (42–75) that this fatty acid alone cannot be reliably used as an indicator of adulteration.

Significant progress has been made by CODEX with input from academics and industry members to develop appropriate standards for the avocado oil fatty acid profile, but how much natural variables such as cultivars, harvest time, and geographic origins may affect fatty acids in pure avocado oil is still not completely understood. In addition, Green and Wang (2023a), highlighted that it is still unknown why some industry-made oils, typically refined oils, have higher stearic fatty acid than what has been seen in lab-made oils and in literature (Green & Wang, 2023a, Ozdemir & Topuz, 2004; Tan et al., 2017, Berasategi et al., 2012, Madawala et al., 2012). It is possible this is caused solely by economically motivated adulteration; however, it has not been investigated if the refining process could be causing this phenomenon.

While continued research is needed on stearic acid in avocado oil, Green and Wang (2022b) demonstrated that changing how oleic fatty acid is reported could aid in the detection of adulteration. Currently, oleic acid is calculated as the sum of 18:1 (n-7) and 18:1 (n-9). However, *cis*-vaccenic acid, which is C18:1 (n-7) was shown to be significantly higher in avocado oil than other seed oils, particularly high oleic safflower and high oleic sunflower oils. All the samples that had more than 5.5% *cis*-vaccenic acid met the fatty acids and sterols standards for avocado oil (data not shown). By reporting the content of these two isomers separately, as well as their sum, it would allow professional buyers to see if the *cis*-vaccenic acid content is low, and thus provide further evidence that an avocado oil may be adulterated with a seed oil.

#### 3.1.2. Sterols profile

The sterols profile is another purity determination method, which is used less often due to its high cost and analysis time. This method is



**Table 2**

Detailed fatty acid results reported as percent of total fatty acids. The proposed CODEX standards as of 2021 are listed above the samples. Any value in red does not fit within these current CODEX ranges.

Code	C16:0	C16:1	C18:0	C18:1	C18:2	C18:3	C20:0	C20:1	C22:0
CODEX 2021 Stds	11.0–26.0	4.0–17.1	0.1–1.3	42.0–75.0	7.8–19.0	0.5–2.1	ND–0.7	ND–0.3	ND–0.5
1	13.09 ± 0.01	3.6 ± 0.0	2.24 ± 0	66.82 ± 0.02	12.66 ± 0.0	0.56 ± 0.0	0.36 ± 0.0	0.25 ± 0.0	0.26 ± 0.01
2	11.28 ± 0.05	2.67 ± 0.0	2.31 ± 0.05	69.71 ± 0.1	12.53 ± 0.02	0.42 ± 0.0	0.38 ± 0.0	0.27 ± 0.0	0.28 ± 0.02
3	12.33 ± 0.02	3.06 ± 0.0	2.11 ± 0.0	66.94 ± 0.05	13.94 ± 0.01	0.5 ± 0.0	0.36 ± 0.02	0.24 ± 0.01	0.37 ± 0.01
4	14.54 ± 0.03	4.81 ± 0.0	1.3 ± 0.02	59.66 ± 0.02	18.14 ± 0.01	0.86 ± 0.01	0.22 ± 0.01	0.22 ± 0.0	0.12 ± 0.0
5	14.5 ± 0.03	4.8 ± 0.0	1.28 ± 0.01	59.77 ± 0.13	18.12 ± 0.05	0.84 ± 0.03	0.22 ± 0.01	0.22 ± 0.0	0.11 ± 0.0
6	13.9 ± 0.01	5.12 ± 0.0	1.41 ± 0.01	59.48 ± 0.02	16.91 ± 0.0	2.16 ± 0.0	0.28 ± 0.0	0.39 ± 0.0	0.22 ± 0.0
7	13.77 ± 0.0	5.06 ± 0.0	1.43 ± 0.0	59.23 ± 0.04	17.25 ± 0.03	2.2 ± 0.0	0.28 ± 0.0	0.40 ± 0.0	0.22 ± 0.0
8	16.53 ± 0.16	7.48 ± 0.02	0.92 ± 0.17	62.85 ± 0.23	11.08 ± 0.07	0.76 ± 0.01	0.07 ± 0.01	0.15 ± 0.0	ND
9	16.38 ± 0.04	7.49 ± 0.01	0.79 ± 0.01	62.98 ± 0.03	11.16 ± 0.02	0.78 ± 0.02	0.08 ± 0.0	0.16 ± 0.0	0.03 ± 0.04
10	14.87 ± 0.1	5.69 ± 0.0	1.17 ± 0.07	58.85 ± 0.02	18.04 ± 0.08	0.66 ± 0.01	0.2 ± 0.03	0.21 ± 0.02	0.16 ± 0.01
11	18.58 ± 0.02	8.2 ± 0.02	0.73 ± 0.0	59.58 ± 0.03	11.61 ± 0.01	0.75 ± 0.0	0.15 ± 0	0.19 ± 0.0	0.06 ± 0.0
12	18.57 ± 0.01	8.19 ± 0.01	0.74 ± 0.0	59.6 ± 0	11.61 ± 0.01	0.75 ± 0.0	0.16 ± 0.01	0.19 ± 0.0	0.04 ± 0.0
13	13.8 ± 0.01	4.99 ± 0.0	1.51 ± 0.01	58.83 ± 0.06	17.43 ± 0.02	2.21 ± 0.0	0.35 ± 0.0	0.42 ± 0.0	0.31 ± 0.08
14	14.19 ± 0.01	4.5 ± 0.0	1.21 ± 0.01	55.27 ± 0.02	23.31 ± 0	0.88 ± 0.0	0.2 ± 0.0	0.22 ± 0.0	0.10 ± 0.0
15	11.43 ± 0.0	1.79 ± 0.0	2.56 ± 0.02	70.9 ± 0.01	11.71 ± 0.0	0.57 ± 0.0	0.43 ± 0.0	0.27 ± 0.02	0.20 ± 0.01
16	11.32 ± 0.03	1.77 ± 0.0	2.56 ± 0.01	71.14 ± 0.04	11.58 ± 0.0	0.57 ± 0.0	0.44 ± 0.01	0.27 ± 0.02	0.22 ± 0.01
17	11.07 ± 0.07	1.58 ± 0.0	2.67 ± 0.05	71.08 ± 0.09	11.82 ± 0.01	0.67 ± 0.0	0.39 ± 0.02	0.29 ± 0.0	0.31 ± 0
18	11.23 ± 0.02	1.9 ± 0.01	2.71 ± 0.01	71.43 ± 0.05	11.01 ± 0.01	0.57 ± 0.0	0.4 ± 0.01	0.27 ± 0.0	0.36 ± 0.03
19	17.02 ± 0.01	6.87 ± 0.01	1.32 ± 0.02	57.3 ± 0.04	15.93 ± 0.01	0.79 ± 0.0	0.27 ± 0.0	0.22 ± 0.0	0.12 ± 0.03
20	15.51 ± 0.26	4.99 ± 0.08	1.48 ± 0.01	65.15 ± 0.61	11.35 ± 0.21	0.76 ± 0.01	0.26 ± 0.01	0.23 ± 0.01	0.12 ± 0.02
21	15.28 ± 0.02	4.93 ± 0.0	1.43 ± 0.0	65.66 ± 0.02	11.21 ± 0.0	0.75 ± 0.0	0.26 ± 0.0	0.23 ± 0	0.09 ± 0.02
22	14.71 ± 0.02	6.27 ± 0.0	0.9 ± 0.03	63.55 ± 0.02	13.09 ± 0.0	0.78 ± 0.02	0.19 ± 0.0	0.2 ± 0.0	0.18 ± 0.0
23	11.01 ± 0.0	1.59 ± 0.0	2.74 ± 0.01	73.41 ± 0.03	9.74 ± 0.0	0.45 ± 0.0	0.36 ± 0.01	0.26 ± 0.0	0.31 ± 0.02
24	9.79 ± 0.01	1.39 ± 0.0	2.66 ± 0.01	73.85 ± 0.03	10.59 ± 0.0	0.55 ± 0.0	0.37 ± 0.0	0.29 ± 0.0	0.39 ± 0.01
25	13.41 ± 0.02	2.91 ± 0.0	1.96 ± 0.0	64.61 ± 0	15.63 ± 0.0	0.61 ± 0.0	0.32 ± 0.0	0.23 ± 0.0	0.2 ± 0.03
26	10.88 ± 0.03	1.62 ± 0.0	2.79 ± 0.03	69.88 ± 0.07	12.98 ± 0.0	0.65 ± 0.0	0.42 ± 0.02	0.28 ± 0.01	0.33 ± 0.04
27	10.82 ± 0.01	1.51 ± 0.02	2.67 ± 0.0	72.7 ± 0.01	10.6 ± 0.01	0.5 ± 0.0	0.42 ± 0.0	0.28 ± 0.0	0.36 ± 0.0
28	10.55 ± 0.02	1.46 ± 0.0	2.77 ± 0.04	71.86 ± 0.01	11.68 ± 0.01	0.56 ± 0.01	0.38 ± 0.0	0.27 ± 0.0	0.34 ± 0.02
29	9.41 ± 0.03	2.08 ± 0.0	2.57 ± 0.01	73.21 ± 0.02	11.01 ± 0.01	0.38 ± 0.0	0.32 ± 0.0	0.26 ± 0.0	0.62 ± 0.01
30	13.57 ± 0.01	4.41 ± 0.0	1.42 ± 0.01	68.46 ± 0.02	10.58 ± 0	0.7 ± 0.0	0.29 ± 0.01	0.23 ± 0.0	0.18 ± 0.0
31	17.55 ± 0.03	8.08 ± 0.01	0.6 ± 0.0	60.95 ± 0.04	11.52 ± 0.01	0.86 ± 0.0	0.12 ± 0.0	0.18 ± 0.0	ND
32	10.79 ± 0.04	0.7 ± 0.0	3.12 ± 0.03	74.32 ± 0.06	9.28 ± 0.01	0.66 ± 0.0	0.48 ± 0.0	0.3 ± 0.0	0.22 ± 0.0
33	11.7 ± 0.01	0.9 ± 0.0	2.93 ± 0.0	72.11 ± 0.01	10.58 ± 0	0.65 ± 0.0	0.48 ± 0.0	0.3 ± 0.0	0.23 ± 0.01
34	16.92 ± 0.04	5.68 ± 0.0	1.36 ± 0.03	61.79 ± 0.05	12.78 ± 0.01	0.82 ± 0.0	0.24 ± 0.0	0.2 ± 0.0	0.09 ± 0.01
35	16.87 ± 0.02	5.77 ± 0.0	1.32 ± 0.03	61.7 ± 0.05	12.89 ± 0.01	0.82 ± 0.0	0.23 ± 0.0	0.19 ± 0.0	0.08 ± 0.0
36	20.95 ± 0.01	10.21 ± 0.01	0.75 ± 0.01	52.31 ± 0.01	14.28 ± 0.0	0.95 ± 0.0	0.13 ± 0.0	0.19 ± 0.0	0.12 ± 0.02

often only used if fatty acid profile data comes up inconclusive and another method is needed to determine purity. However, the most effective way to determine purity is to use both sterols and fatty acid profile. Table 3 shows the sterols for the oils in this study Table 4 summarizes all the data from this study as well as listing which samples passed/failed the purity standards. There were ten refined oils that passed the new sterols parameters (including sample 12). The CODEX standards were recently amended for the stigmastanol lower limit to be 0.3 instead of ND, however, Green and Wang (2023a) demonstrated that many pure oils can have ND levels of stigmastanol. Sample 12 passed all fatty acid purity parameters as well as all sterols except it has an ND level of stigmastanol. Considering the previous research on pure avocado oil, this sample was listed as passing. All of the virgin/extra virgin oils passed the sterols parameters except for 32 and 33, which had low campesterol. These two samples also had several fatty acids out of range, indicating EMA is occurring and a high adulteration percentage is likely. Three samples (6, 7 and 13) had an elevated level of brassicasterol, which is a known canola oil indicator. Given the similarity of the sterols and fatty acid profiles in these three samples it is possible that they originated from the same supplier who committed to EMA. It is worth noting that these three samples had fatty acids that were either within the acceptable range or only slightly outside the proposed limits so if only fatty acids, without sterols, was used to check purity, these adulterated samples may have passed as pure avocado oil.

Known adulterants of avocado oil are high oleic safflower and high oleic sunflower oil, and although their chemical compositions can vary, adulteration with these oils is often characterized by an elevated stearic fatty acid level and an elevated delta-7-stigmastanol value and possible delta-7-avenasterol value (Codex Alimentarius Commission, 2021b).

These sterols trends were also seen in the confirmed adulterated samples from the first market analysis study in 2020 (Green & Wang, 2020). Although many samples passed the proposed sterols parameters, there is still a debate on the appropriate limit for the delta-7 sterols. Based on the results from Green and Wang (2023a), it is possible the 3.5 limit is too high, and CODEX should consider adopting the lower 1.5 limit that was also proposed. In this study all of the samples (1, 15, 17, 25, and 28) that had a delta-7-stigmastanol level over 2.5%, also did not pass the stearic fatty acid content (high) and had a palmitoleic content that was too low, indicating there is a high probability these samples are adulterated.

There are other samples (20, 21, 30, and 34) that had an elevated stearic fatty acid value without also having high delta-7-content and passed all the remaining fatty acid profile parameters, as well as the sterols parameters. All four of these samples had palmitoleic content on the lower end, with 20, 21 and 30 at or below 5.0%. Cases like this are still difficult to determine as adulteration with high oleic safflower or high oleic sunflower oils can lead to this type of fatty acid and sterols profile. Adulteration is often accompanied with higher levels of the delta-7 sterols, and if this were the case, it would be much more likely. However, according to the CODEX parameters pure high oleic safflower and sunflower oils can have non-detectable amounts of both delta-7 sterols (Codex Alimentarius Commission, 2021b). Therefore, it is still possible that adulteration is going on albeit, much more difficult to confirm. It is imperative that further studies are done to understand if refining can contribute to elevated delta-7 sterols and stearic fatty acid, and if so, investigate other ways to detect adulteration in avocado oil, as differentiating it between high oleic safflower and high oleic sunflower oils is difficult.

**Table 3**

Detailed sterols results reported as percent of total sterols. The proposed CODEX standards as of 2021 are listed above the samples Sterols are abbreviated and end in -sterol, with the exception of delta-7-stigmastenol. Any value in red does not fit within these current CODEX ranges.

Code	Brassica	Campe	Stigma	Clero	B-sito	Delta-5-avena	Delta-7-stigma	Delta-7-avena
CODEX 2021 Stds	ND-0.5	4.0–8.3	0.3–2.0	1.0–2.0	79.0–93.4	2.0–8.0	ND-3.5	ND-1.5
1	ND	7.57 ± 0.00	2.64 ± 0.30	1.4 ± 0.0	78.92 ± 0.01	4.94 ± 0.1.0	3.38 ± 0.12	1.15 ± 0.09
2	ND	8.74 ± 0.16	2.61 ± 0.15	0.95 ± 0.02	75.1 ± 1.81	5.49 ± 0.38	5.79 ± 1.64	1.33 ± 0.10
3	ND	8.34 ± 0.01	3.74 ± 0.13	0.87 ± 0.03	75.96 ± 0.06	4.53 ± 0.1.0	4.85 ± 0.00	1.71 ± 0.14
4	ND	8.31 ± 0.05	1.73 ± 0.22	1.27 ± 0.14	81.42 ± 0.69	6.55 ± 0.18	0.37 ± 0.18	0.36 ± 0.03
5	ND	8.26 ± 0.29	1.74 ± 0.06	1.34 ± 0.16	80.81 ± 1.23	6.82 ± 0.34	0.58 ± 0.29	0.45 ± 0.09
6	2.10 ± 0.04	15.68 ± 0.14	2.05 ± 0.21	1.06 ± 0.08	72.77 ± 0.55	5.38 ± 0.41	0.65 ± 0.12	0.3 ± 0.06
7	2.33 ± 0.14	16.32 ± 0.48	2.09 ± 0.28	1.02 ± 0.33	69.39 ± 1.39	6.31 ± 0.38	1.7 ± 0.42	0.83 ± 0.32
8	ND	5.85 ± 0.04	0.56 ± 0.03	1.86 ± 0.25	89.62 ± 0.4	2.11 ± 0.08	ND	ND
9	ND	5.96 ± 0.14	0.61 ± 0.09	1.73 ± 0.09	89.6 ± 0.36	2.10 ± 0.04	ND	ND
10	ND	10.64 ± 0.18	3.0 ± 0.01	1.13 ± 0.16	77.41 ± 0.25	5.57 ± 0.31	1.56 ± 0.05	0.69 ± 0.01
11	ND	6.95 ± 0.05	0.47 ± 0.20	1.45 ± 0.13	85.73 ± 1.14	5.40 ± 1.12	ND	ND
12	ND	6.58 ± 0.01	ND	1.42 ± 0.04	87.07 ± 0.14	4.92 ± 0.09	ND	ND
13	2.07 ± 0.19	16.1 ± 0.26	1.94 ± 0.25	1.16 ± 0.06	70.52 ± 0.81	5.85 ± 0.03	1.63 ± 0.27	0.72 ± 0.28
14	ND	9.86 ± 0.07	2.49 ± 0.09	1.15 ± 0.04	79.48 ± 0.15	6.41 ± 0.02	0.33 ± 0.07	0.29 ± 0.00
15	ND	4.62 ± 0.04	1.73 ± 0.03	0.87 ± 0.04	83.72 ± 0.21	5.05 ± 0.14	2.63 ± 0.15	1.39 ± 0.20
16	ND	4.81 ± 0.05	1.81 ± 0.13	0.94 ± 0.06	82.49 ± 0.62	4.82 ± 0.13	3.96 ± 0.19	1.16 ± 0.32
17	ND	6.44 ± 0.01	3.46 ± 0.27	1.57 ± 0.51	79.61 ± 0.72	4.41 ± 0.08	3.36 ± 0.18	1.15 ± 0.14
18	ND	4.92 ± 0.04	2.57 ± 0.37	0.88 ± 0.20	82.42 ± 0.63	3.84 ± 0.15	4.28 ± 0.08	1.09 ± 0.34
19	ND	8.06 ± 0.08	1.67 ± 0.16	1.23 ± 0.08	83.05 ± 0.49	5.32 ± 0.30	0.38 ± 0.17	0.29 ± 0.03
20	ND	6.92 ± 0.05	0.68 ± 0.02	1.57 ± 0.12	84.12 ± 0.28	6.06 ± 0.25	0.33 ± 0.13	0.33 ± 0.06
21	ND	6.89 ± 0.10	0.69 ± 0.03	1.38 ± 0.04	84.52 ± 0.24	6.01 ± 0.31	0.21 ± 0.07	0.29 ± 0.02
22	ND	5.73 ± 0.02	1.28 ± 0.16	1.26 ± 0.24	83.46 ± 0.97	5.54 ± 0.51	1.98 ± 0.18	0.75 ± 0.26
23	ND	8.06 ± 0.09	3.83 ± 0.40	1.20 ± 0.35	75.05 ± 1.21	4.03 ± 0.20	5.99 ± 0.44	1.83 ± 0.43
24	ND	5.51 ± 0.01	3.56 ± 0.46	0.76 ± 0.14	78.99 ± 0.46	3.36 ± 0.24	6.34 ± 0.06	1.48 ± 0.17
25	ND	6.39 ± 0.04	2.09 ± 0.15	1.23 ± 0.22	80.62 ± 0.80	5.84 ± 0.35	2.87 ± 0.30	0.96 ± 0.18
26	ND	7.19 ± 0.04	3.41 ± 0.38	0.85 ± 0.04	75.55 ± 0.71	5.45 ± 1.36	5.62 ± 0.17	1.94 ± 0.52
27	ND	7.21 ± 0.40	3.12 ± 0.54	0.80 ± 0.08	76.52 ± 2.97	5.28 ± 0.89	5.34 ± 1.29	1.72 ± 0.56
28	ND	5.29 ± 0.03	2.93 ± 0.21	0.72 ± 0.13	81.98 ± 1.54	4.6 ± 0.24	3.27 ± 0.61	1.21 ± 0.32
29	ND	8.66 ± 0.05	6.33 ± 0.32	0.99 ± 0.31	66.58 ± 2.82	4.11 ± 0.27	9.69 ± 2.16	3.65 ± 0.96
30	ND	5.9 ± 0.03	1.70 ± 0.42	1.45 ± 0.13	82.29 ± 1.41	5.93 ± 0.38	1.94 ± 0.18	0.79 ± 0.33
31	ND	6.11 ± 0.05	0.46 ± 0.27	1.82 ± 0.13	85.39 ± 0.78	6.21 ± 0.33	ND	ND
32	ND	3.48 ± 0.05	1.74 ± 0.31	0.96 ± 0.12	87.44 ± 0.06	5.51 ± 0.27	0.58 ± 0.15	0.29 ± 0.03
33	ND	3.27 ± 0.07	1.40 ± 0.24	1.49 ± 0.20	87.11 ± 0.21	6.10 ± 0.22	0.37 ± 0.05	0.24 ± 0.08
34	ND	6.08 ± 0.02	0.33 ± 0.18	1.76 ± 0.01	83.89 ± 0.07	7.94 ± 0.07	ND	ND
35	ND	6.05 ± 0.01	0.60 ± 0.42	1.65 ± 0.04	84.29 ± 0.68	7.41 ± 0.22	ND	ND
36	ND	7.84 ± 0.07	0.76 ± 0.14	2.09 ± 0.25	83.89 ± 0.27	5.42 ± 0.06	ND	ND

### 3.1.3. Triacylglycerol analysis

Triacylglycerols, TAGs, can also be used to determine avocado oil purity. Fig. 1 shows two of the sample sets discussed in section 3.1.2 on the TAG/PCA plot that was previously developed in the Green and Wang (2023b). The first group of samples (1, 15, 17, 25, and 28) had an elevated C18:0, low C16:1, but a delta-7 stigmastenol content under the current 3.5% standard, but still was over our proposed upper limit of 2.5%. All of these samples are outside of the avocado oil cluster and are located in the bottom left quadrant along with the pure high oleic safflower and high oleic sunflower clusters, indicating that they are adulterated with high amounts of either of these two oils. This also further confirms that samples with high amounts of delta-7 stigmastenol are more likely to be adulterated with high oleic safflower and sunflower oils. The TAGs can also be useful when the purity of samples is unclear from fatty acids and sterols analysis, like in the cases of 20, 21, 30, and 34, these four ambiguous samples, which passed all purity parameters except a slightly elevated stearic fatty acid value show different results. Sample 34 is right on the edge of the 95% confidence ellipse in the avocado cluster, indicating that this sample is likely pure. Compared to the other three oils in this group, it had a higher palmitoleic content, which is more consistent with a pure avocado oil. Samples 20, 21, and 30 are further away and there is a higher chance they could be adulterated with a smaller amount high oleic sunflower or high oleic safflower oil. The avocado oil cluster used in this plot does have some limitations, it was created using samples from California and Mexico and does not include refined oils, however, samples 20, 21, and 30 were stated to originate from Mexico (Table 1). Other factors, such as oil quality and cost, that professional buyers can consider when choosing an oil are discussed below in sections 3.2 and 3.3, respectively.

### 3.2. Quality parameters

Although there has been significant progress to adopting a set of avocado oil standards, the primary focus of these efforts has been on oil purity to combat EMA, as this is the biggest risk to both consumer health and genuine producers in the industry. Oil quality has not been a priority for the industry or standard development agencies and work still needs to be done to differentiate what the limits should be for refined avocado oil and extra virgin avocado oil. Therefore, this study used the extra virgin limits proposed in the Green and Wang (2022a) oil quality study, which were built off the work done by Woolf et al. (2009). Because that study did not analyze refined oils, those limits will be based off Woolf et al. (2009) and standards proposed by CODEX in 2019.

#### 3.2.1. Free fatty acid analysis

Free fatty acids in the oil are an indicator of using poor quality fruit to make oil, which can happen on or off the tree for example, using overripe fruits (Green & Wang, 2022a), fruits with insect bites or improper handling/excessive heat in processing (Woolf et al., 2009). This can result in the fatty acids separating from the triacylglycerol, compound that makes up oil, and becoming “free” in the oil. The free fatty acid content is displayed in Fig. 2a. With Tables 4 and 5 summarizing the number of samples that passed purity and quality data. Proposed CODEX standards from 2019, as well as Woolf et al. (2009), suggested that refined avocado oil should have values that are less than 0.1%. Most refined oils in this study met this proposed standard, with only four of the 29 refined samples not passing and, only one of those four samples (number 22) was likely to be pure avocado oil. The extra virgin oils have a higher FFA than refined oils, which is expected since

**Table 4**

Summary of quality and purity parameters. Values highlighted in blue do not pass *extra virgin* avocado oil standards and those highlighted in red do not pass the *refined* oil standards. Refined oil standards are from the CODEX proposal; extra virgin oil standards FFA and PV are from [Green et al. \(2020\)](#) and delta K from the IOC (CODEX does not currently have EV proposed standards).

Sample Code	Label descriptors	Product origin	FFA (% oleic acid)	PV (meq O <sub>2</sub> /kg)	UV: Delta K (ΔK)	Fatty acid profile	Sterols profiles
Refined Standards <sup>a</sup>			≤0.1	≤2.0	N/A		
EV Standards <sup>a</sup>			≤0.8	≤10.0	≤0.01		
1	Refined	Mexico	0.19 ± 0.01	2.09 ± 0.14	0.04 ± 0.00	Fail	Fail
2	Refined	Mexico	0.25 ± 0.01	2.18 ± 0.28	0.05 ± 0.00	Fail	Fail
3	Refined	Spain	0.13 ± 0.00	3.97 ± 0.01	0.04 ± 0.00	Fail	Fail
4	Refined	USA, Mexico	0.07 ± 0.00	3.08 ± 0.15	0.07 ± 0.00	Pass	Pass
5	Refined	USA, Mexico	0.08 ± 0.00	3.47 ± 0.15	0.06 ± 0.00	Pass	Pass
6	Refined	Mexico, South Africa, France	0.09 ± 0.00	1.79 ± 0.00	0.06 ± 0.00	Fail	Fail
7	Refined	Mexico, South Africa, France	0.10 ± 0.00	1.09 ± 0.14	0.06 ± 0.00	Fail	Fail
8	Refined & expeller pressed	France	0.04 ± 0.00	1.00 ± 0.00	0.01 ± 0.01	Pass	Pass
9	Refined & expeller pressed	France	0.03 ± 0.00	1.09 ± 0.14	0.00 ± 0.00	Pass	Pass
10	Refined & expeller pressed	Mexico	0.09 ± 0.01	2.18 ± 0.02	0.05 ± 0.00	Pass	Fail
11	Refined & expeller pressed	South Africa	0.08 ± 0.00	6.05 ± 0.13	0.01 ± 0.00	Pass	Pass
12	Refined & expeller pressed	South Africa	0.09 ± 0.00	6.67 ± 0.17	0.01 ± 0.00	Pass	Pass <sup>b</sup>
13	Refined & expeller pressed	Mexico	0.10 ± 0.01	3.08 ± 0.16	0.05 ± 0.00	Fail	Fail
14	Refined & expeller pressed	Mexico	0.06 ± 0.00	3.17 ± 0.00	0.08 ± 0.00	Fail	Fail
15	Refined & cold pressed	Spain	0.13 ± 0.00	3.08 ± 0.43	0.05 ± 0.00	Fail	Fail
16	Refined & cold pressed	Spain	0.13 ± 0.00	4.28 ± 0.43	0.07 ± 0.02	Fail	Fail
17	Refined & cold pressed	Mexico, Spain, USA	0.11 ± 0.00	0.7 ± 0.14	0.05 ± 0.00	Fail	Fail
18	Refined & cold pressed	Mexico, Spain, USA	0.13 ± 0.01	1.79 ± 0.00	0.06 ± 0.00	Fail	Fail
19	Unspecified	Mexico	0.11 ± 0.01	1.78 ± 0.28	0.03 ± 0.00	Pass	Pass
20	Unspecified	Mexico	0.10 ± 0.00	4.58 ± 0.01	0.05 ± 0.00	Fail	Pass
21	Unspecified	Mexico	0.09 ± 0.00	4.27 ± 0.14	0.05 ± 0.00	Fail	Pass
22	Unspecified	Mexico	0.17 ± 0.01	2.08 ± 0.14	0.02 ± 0.00	Pass	Pass
23	Unspecified	Mexico	0.15 ± 0.01	2.29 ± 0.14	0.04 ± 0.00	Fail	Fail
24	Unspecified	Mexico	0.10 ± 0.00	0.79 ± 0.0	0.09 ± 0.00	Fail	Fail
25	Unspecified	Mexico	0.14 ± 0.00	4.28 ± 0.42	0.08 ± 0.00	Fail	Pass
26	Cold pressed	Spain	0.13 ± 0.00	1.49 ± 0.15	0.04 ± 0.00	Fail	Fail
27	Cold pressed	Mexico, Spain, USA	0.13 ± 0.00	1.19 ± 0.00	0.04 ± 0.00	Fail	Fail
28	Cold pressed	Mexico, Spain, USA	0.12 ± 0.00	2.78 ± 0.00	0.05 ± 0.00	Fail	Fail
29	Cold pressed	Mexico, Spain, USA	0.09 ± 0.00	0.8 ± 0.00	0.07 ± 0.00	Fail	Fail
30	Virgin/Extra virgin	Mexico	0.76 ± 0.01	5.28 ± 0.15	0.03 ± 0.00	Fail	Pass
31	Extra Virgin	Mexico	1.71 ± 0.00	3.28 ± 0.43	0.00 ± 0.00	Pass	Pass
32	Extra virgin	Spain	0.12 ± 0.00	3.57 ± 0.27	0.05 ± 0.00	Fail	Fail
33	Extra virgin	Spain	0.12 ± 0.00	3.98 ± 0.01	0.06 ± 0.00	Fail	Fail
34	Virgin	Mexico	0.73 ± 0.01	8.77 ± 0.01	0.01 ± 0.00	Fail	Pass
35	Virgin	Mexico	0.73 ± 0.01	8.66 ± 0.72	0.01 ± 0.00	Pass	Pass
36	Extra virgin	Mexico	1.39 ± 0.00	4.67 ± 0.70	0.01 ± 0.00	Pass	Pass

<sup>a</sup> Samples were considered passing if, when accounting for their standard deviation, they would fit into the proposed standards.

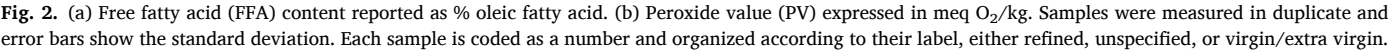
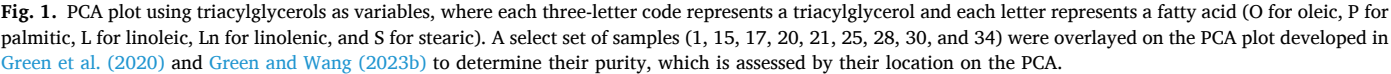
<sup>b</sup> This sample would fail if the current CODEX standards were accepted due to ND levels of stigmaterol, however, research has shown that pure oils often have ND levels of this sterol. Due to this being the only value out of range we believe it is pure, and thus was considered passing.

the refining process removes free fatty acids from the oil. Based on results from [Green and Wang \(2022a\)](#), it was recommended that the avocado oil extra virgin limit be raised to 0.8% from Woolf's original 0.5% limit. Using 0.8%, two extra virgin oils were outside the range, 31 and 36; however, these two oils were confidently confirmed as pure. The two extra virgin oils with the lowest FFA, 32 and 33, may look to be the best quality, however, they are not 100% avocado oil and failed both fatty acid and sterols profile purity analyses ([Table 4](#)). The low FFA indicates they are also possibly refined, which is discussed in the UV absorbance section [3.2.3](#).

### 3.2.2. Peroxide value

Peroxide value measures the oxidation in oil in the form of peroxides, which can be created via photooxidation, autooxidation, and thermal oxidation, and oxygen exposure over time, such as opening the bottle. [Woolf et al. \(2009\)](#) proposed 0.5 meq O<sub>2</sub>/kg to be the upper limit for PV

for refined avocado oils and standards proposed by Mexico for CODEX in 2019 suggested a limit 2.0 meq O<sub>2</sub>/kg for refined oils. The peroxide values are shown in [Fig. 2b](#). Taking the more lenient limit of 2.0 meq O<sub>2</sub>/kg, there were 15 refined oils that did not pass. [Table 1](#) shows there was not a correlation with PV and the type of storage container used, as clear bottles can increase the chance of photooxidation. In addition, all these oils were analyzed well before their best by dates, however, excessive heat or light exposure during sample transportation and storage may have increased the rate of peroxide production. The refining process removes peroxides; therefore, virgin/extra virgin oils have higher PV limits. Our study from 2022 ([Green & Wang, 2022a](#)) demonstrated that a PV limit of 10.0 meq O<sub>2</sub>/kg is appropriate and attainable for virgin/extra virgin avocado oils. [Table 4](#) shows that all of the virgin/extra virgin samples met our proposed PV limit of less than or equal to 10.0 meq O<sub>2</sub>/kg.



**Table 5**

Summary of total samples passing or failing standards. This table does not account for tocopherol data, as it is a minor component that is not an official quality or purity parameter.

	Number of samples	Samples met quality (FFA and PV) proposed standards <sup>a</sup>	Samples met purity (fatty acid and sterol profiles) proposed standards	Samples met both quality and purity proposed standards
Refined/Unspecified/Ambiguous	29	11	8	3
Virgin/Extra Virgin	7	2 <sup>b</sup>	3	1
Total	36	13	11	4

<sup>a</sup> It was assumed that any sample not explicitly labeled EV/V was refined.

<sup>b</sup> Samples 30, 32 and 33 were excluded as the UV data showed they contained refined oil and therefore not virgin/extra virgin.

### 3.2.3. UV absorbance

Another way to measure oil oxidation is through measuring the UV absorbances, measuring at a wavelength of 232 nm ( $K_{232}$ ) detects peroxides, like the peroxide value, however, it can also detect a wider variety of primary oxidation products. Secondary oxidation products are measured at a wavelength 270 nm ( $K_{270}$ ), which are often formed in high heat and thus values tend to be higher for refined oils. The delta K value is a unitless number calculated through the comparison of other UV absorbances, which was developed to detect the presence of refined oil if the value is over 0.01 (Vossen, 2007). The specific extinction in UV data is shown in Fig. 3. All of the  $K_{232}$  values are comparable across refined and virgin/virgin samples. However, there is a visible trend where samples with a low  $K_{270}$ , often also have a low delta K value. From this data, as expected from the FFA results, samples 32 and 33 are not virgin/extra virgin as they contained refined oil. However, these samples also had the highest price of the virgin/extra virgin oils at 0.83 cents/oz, which shows that a high price cannot be used as an indicator for good quality or purity. Interestingly, sample 36 was also 0.83 cents/oz however this sample is pure and unrefined (although its elevated FFA brings it below extra virgin quality). Sample 30 has values in between many of the refined and virgin/extra virgin samples and it is possible that it is a blend between the two and mislabeled as virgin/extra virgin. This sample also looked to be adulterated with a portion of high oleic safflower of high oleic sunflower oil (Fig. 1) the adulterant oil was likely refined and the source of the quality results.

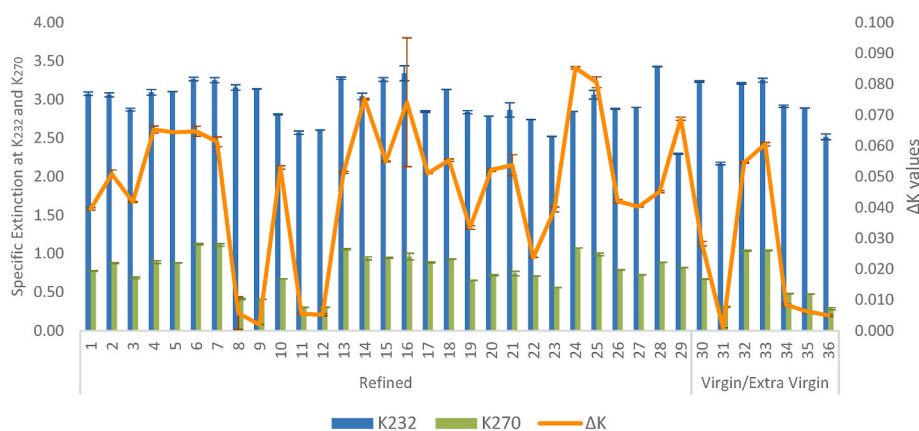
These results also demonstrate the ambiguity and discrepancies in the current labeling of avocado oils. A cold pressed oil is one that is inherently unrefined, it is obtained mechanically without the use of excessive heat or solvent (Codex Alimentarius Commission, 2021b). These oils are expected to be of virgin/extra virgin quality. Table 1 shows there are two sets of samples labeled either refined & cold pressed (15–18), a contradictory label, or only cold pressed (26–29) but without a virgin/extra virgin quality label. Both sets of samples have a delta K values significantly over 0.01 and thus have likely undergone refining.

They were also light in color and had low FFA values compared to the virgin/extra virgin oils, which supports our interpretation of these oils being refined as the refining process removes free fatty acids and the natural green color of avocado oil.

There are currently no proposed avocado oil standards for the specific extinction values or delta K, however, they were included in this study due to their utility to detect presence of refined oil. All values can be determined at once with minimal sample preparation, oil dilution. It also eliminates the inherent user bias associated with performing the titration for peroxide value.

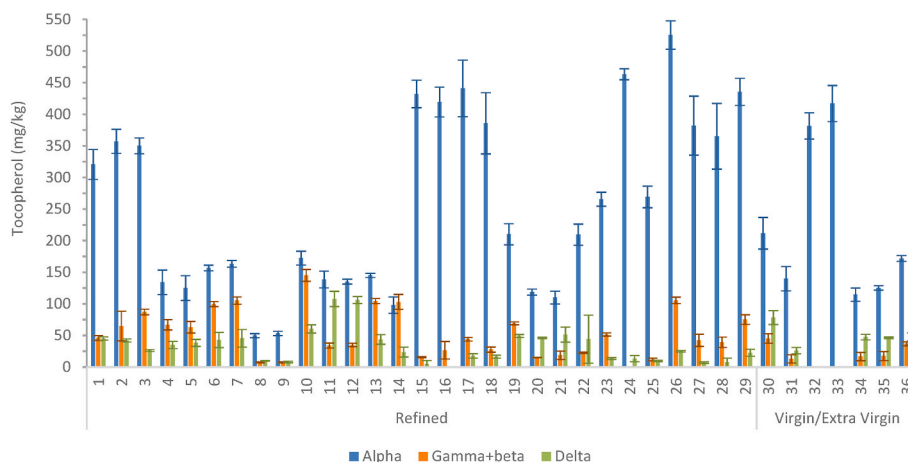
### 3.3. Minor components

Tocopherols are not currently used as a purity parameter; however, they help makeup the vitamin E content in oils, along with tocotrienols. The CODEX standards for tocopherols are in the newer stages of development and were analyzed here to help gain an understanding of what the tocopherol content looks like in market avocado oils. Tocopherols are often removed in the refining process and then added back in, so the profiles of the refined oils do not necessarily represent the tocopherols naturally present in avocado oil and these differences need to be specified in standards. The tocopherol content is shown graphically in Fig. 4 and listed in Table S2. All of the extra virgin oils except the two that were known to be refined oils had tocopherol profiles within the new proposed standards. Interestingly, the majority of the refined oils also had tocopherols that were within the limits, except for the samples that had “refined and cold-pressed” or “cold-pressed” on the label, all of which had higher amounts of alpha tocopherols than expected. The refining process still removes tocopherols even if the oil was cold pressed before refining. Thus, it is most likely that tocopherols were added in at higher concentrations after refining for these samples, rather than the processing impacting the tocopherol content. Although CODEX is considering to add tocopherol profiles to standards, it should be noted that although tocopherols can be used to gain more information about



**Fig. 3.** Values for the primary oxidation products ( $K_{232}$ ) and secondary oxidation products ( $K_{270}$ ) shown on the left axis and the refining indicator,  $\Delta K$  on the right. Samples were measured in duplicate and error bars show the standard deviation. Each sample is coded as a number and organized according to their label, either refined, unspecified, or virgin/extra virgin.





**Fig. 4.** Samples were measured in triplicate and error bars show the standard deviation. Each sample is coded as a number and organized according to their label, either refined, unspecified, or virgin/extra virgin.

an oil, they are not reliable compounds to use to determine oil authenticity. Because they can be removed in refining and then added back in afterwards, this could allow for tocopherols to be spiked into the oil to make it appear as if it fits within the avocado oil standards, even if the oil is not authentic.

### 3.4. Information for professional buyers

Table 5 summarizes the results from this study, including the number of samples that passed purity and quality parameters. Although these numbers seem discouraging, as only three refined samples and one virgin/extra virgin sample passed both purity and quality standards, this study identified trends in adulterated samples so that professional buyers can use this information to make more educated choices on their suppliers, which are listed in Table 6. If there is a slightly elevated stearic acid value accompanied by a slightly elevated delta-7-stigmastenol and delta-7-avenasterol then adulteration with a seed oil, primarily sunflower or safflower oil is likely. Furthermore, most adulterant oils have low palmitoleic fatty acid content so if the previously

mentioned trends are seen in addition to a palmitoleic content that is on the bottom end of the range, or just outside of standard range this can also be used as an adulteration indicator. If oleic acid content is high while the previous trends are seen then the adulteration is likely to be specifically with high oleic safflower or high oleic sunflower oil, rather than with canola or soybean oil. If there is an elevated brassicasterol value, then adulteration with canola oil is likely, especially when it is accompanied by a low palmitic acid. Also, generally, the greater the number of fatty acids and sterols that do not pass and the more significantly that each is out of range, the more likely that EMA is occurring.

In terms of ensuring oil quality, virgin/extra virgin oils should be green in color and have some mild flavors. Refined oils range from yellow to clear in color and are free of flavors. In addition, they should ensure that the label of the oil being advertised to them does not contain discrepancies and matches the product; an oil cannot be both refined (or expeller pressed) and cold pressed. A virgin/extra virgin oil should not have undergone refining and thus the color would be expected to be green instead of yellow to clear. Professional buyers should avoid products that have common sensory defects such as rancidity which are markers for oxidation and shorten shelf life. To ensure the oil is free of rancidity, it is advisable to test oil quality not only at the point of production but throughout the time before best-by date. An oil with high FFA tested after production will have shorter shelf life than an oil with low FFA as free fatty acids can accelerate oxidation.

Prices are a top concern for professional buyers, as it is for consumers, in addition to the product quality and safety. The average cost for the refined samples from this study was 0.53 cents/oz and of the samples that failed both fatty acids, sterols and were clearly adulterated according to the TAGs/PCA, the price averaged 0.40 cents/oz. The six cheapest refined samples, which were all under 0.40 cents/oz, were all in the set of samples that failed both fatty acids, sterols and TAGs/PCA. Thus, always trying to buy the lowest-cost oil increases risk of purchasing an adulterated product. However, even though low cost can indicate a higher probability for adulteration, high cost does not guarantee a pure sample of appropriate quality. Not only were samples 32 and 33 not virgin/extra virgin, as labeled, but they were also highly adulterated with refined oil that is cheaper than avocado oil. However, they were two of the most expensive samples in this study and of the virgin/extra virgin oils at 0.83 cents/oz compared to the 0.74 cents/oz average for the other virgin/extra virgin oils. This is a crucial finding, and it demonstrates to professional buyers that high cost does not ensure an unadulterated, high-quality product. The two most expensive refined samples (4 and 5) were determined to be pure, however they were oxidized. It is possible that, because the higher prices, these two samples have been in the warehouse or store shelf for some time and oxidation

**Table 6**  
Indicative fatty acids and sterols of common adulterants detected in avocado oil, HO = high oleic.

		Change in concentration	Potential adulterant (oil)
Key fatty acid	Palmitic acid (16:0)	Increase	HO safflower, HO sunflower, canola
	Palmitoleic acid (16:1)	Decrease	HO safflower, HO sunflower, soybean, canola
	Stearic acid (18:0)	Increase	HO safflower, HO sunflower, soybean
	Oleic acid (18:1)	Decrease	Soybean
	Linoleic acid (18:2)	Increase	Soybean, canola
	Linolenic acid (18:3)	Increase	Soybean, canola
Key sterols	Brassicasterol	Increase	Canola
	Campesterol	Increase	HO safflower, soybean, canola
	Stigmasterol	Increase	HO safflower, HO sunflower, soybean
	Beta-sitosterol	Decrease	HO safflower, HO sunflower, soybean, canola
	Delta-7-stigmastenol	Increase	HO safflower, HO sunflower, soybean
	Delta-7-avenasterol	Increase	HO safflower, HO sunflower, soybean

started to take place. On the other hand, samples 8, 9, and 19 were all pure and of good quality while being fairly average in price at 0.53 cents/oz for samples 8 and 9 and 0.44 cents/oz for sample 19. This shows that good quality, pure avocado oils do exist and can be purchased by professional buyers at a reasonable cost while also having confidence in the product.

We use the word “cold press” in this article to be consistent with the labels on the bottles of the oil we analyzed, however, “cold press” is an obsolete term that the industry should stay away from. In modern avocado oil processing facilities, virgin/extra virgin oil is made through centrifugation instead of the traditional press, thus the word “cold press” misinforms consumers about the avocado oil extraction process. In addition, avocado oil is a perishable item, and it should be treated as such with a disclosed best-before date and harvest date (for virgin/extra virgin). Declaration of product grade (virgin/extra virgin, refined, or a mixture of both) and the product origin should be accurate and clear. Professional buyers can request these product details such as product origin, harvest and post-harvest protocols, extraction/refining methods from a potential supplier as well as a Certificate of Analysis, ideally performed by an independent, third-party laboratory that includes purity and quality parameters outlined in this study. They can then compare the values to current standards (or proposed standards) and use the guide in Table 6 to make an educated decision on sample purity.

#### 4. Conclusions

This study demonstrates that although progress is being made in standard development since our first market study in 2020, there are still issues with purity in avocado oil and these issues extend significantly into private label oils. Out of 29 refined samples, three met both quality and purity standards and eight met current proposed purity standards (Table 5). Out of seven virgin/extra virgin samples, one met both quality and purity standards and three met current proposed purity standards. Although improvements need to be made, there are samples available that are pure, good quality, and available at a reasonable price. The best way to determine if an avocado oil is pure and of good quality is not with one specific method, but a combination of testing approaches including fatty acid profile, sterols profile, and the possible addition of TAGs for oil purity and using FFA and PV, with the potential of PV being replaced by UV, for oil quality. More research and coordinated efforts between industry, government agencies, and researchers are needed to establish enforceable standard so consumers can have confidence in the avocado oil products they purchase, and honest producers can make a living by competing in a fair market. With the popularity of avocado oil and the increasing number of private label brands, this work provides practical information to help professional buyers make educated decisions on what products to purchase to ensure that they are selling pure oils of appropriate quality.

#### CRediT authorship contribution statement

**Hilary S. Green:** Methodology, Software, Validation, Formal analysis, Data curation, Investigation, Writing – original draft, Writing – review & editing, Visualization, Funding acquisition. **Selina C. Wang:** Conceptualization, Methodology, Investigation, Resources, Supervision, Writing – review & editing, Project administration, Funding acquisition.

#### Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

#### Data availability

Data will be made available on request.

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#### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.foodcont.2023.109837>.

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# EXHIBIT 4





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# First report on quality and purity evaluations of avocado oil sold in the US

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### ABSTRACT

The demand for avocado oil has increased significantly as consumers resonate with its potential health benefits, however, due to the lack of enforceable standards, consumers are unprotected from fraud (i.e., economic motivated adulteration). This study analyzed avocado oils currently on the market in the US to evaluate their quality (e.g., free fatty acidity, peroxide value, UV absorbances, vitamin E) and purity (e.g., fatty acids, sterols, triacylglycerols). Our results showed that the majority of commercial samples were oxidized before reaching the expiration date listed on the bottle. In addition, adulteration with soybean oil at levels near 100% was confirmed in two “extra virgin” and one “refined” sample. These findings demonstrate there is an urgent need to develop standards for avocado oil not only to ensure the consumers receive high quality and authentic products but to establish a level playing field to support the continuing growth of global avocado oil industry.

## 1. Introduction

The world's production of avocados increased one million tonnes from 2014 to 2017 and is projected to continue rising with Mexico accounting for one third of the world's production (Altendorf, 2019). Consumer demand for the fruit is largely due to the health benefits associated with avocados, which have high amounts of mono-unsaturated fatty acids and antioxidants (Fernandes, Gómez-Coca, Pérez-Camino, Moreda, & Barrera-Arellano, 2018; Wang et al., 2019; Wong, Requejo-Jackman, & Woolf, 2010). The rising popularity of avocados has also led to the rise in avocado products, namely avocado oil.

Competition in the market place for avocado oil continues with one major boundary, there are currently no standards to determine if an avocado oil is of the quality advertised and authentic. Oils that are of poor quality or blended with cheaper edible oil can be traded and sold at lower prices than high quality or authentic products leaving bulk buyers, food service professionals and consumers unprotected. With no standards available, there is no way to ensure avocado oil is safe. Standards developed for edible oils commonly fall into two categories, quality and purity. Quality can be controlled by the fruit used to make the oil, extraction process, storage; it's mostly related to level of hydrolysis of the fruit and oxidation of the oil (Woolf et al., 2009). An oil is considered pure or authentic if there are no other additives or oils present other than what is listed on the label.

So far, much of literature has focused on improving extraction

methods for avocado oil (Corzzini, Barros, Grimaldi, & Cabral, 2017; Dos Santos, Alicieo, Pereira, Ramis-Ramos, & Mendonça, 2014; Krumreich, Borges, Mendonça, Jansen-Alves, & Zambiasi, 2018; Ortiz Moreno, Dorantes, Galíndez, & Guzmán, 2003; Ramírez-Anaya, Manzano-Hernández, Tapia-Campos, Alarcón-Domínguez, & Castañeda-Saucedo, 2018; Tan & Ghazali, 2019; Werman & Neeman, 1987). There have also been multiple studies chemically characterizing avocado oil based on cultivar (Fernandes et al., 2018; Manaf, Rahardjo, Yusof, Desa, & Nusantara, 2018; Yanty, Marikkar, & Long, 2011) and region (Donetti & Terry, 2014; Tan, Tan, & Tan, 2017). However, there is a need to understand the range in quality and purity of the avocado oils currently on the market and how chemical composition of these oils compare to avocado oils characterized in literature. A few studies have done this on a small scale (Fernandes et al., 2018; Flores, Perez-Camino, & Troca, 2014; Werman & Neeman, 1987), however, to our knowledge no study has comprehensively evaluated the quality and purity of avocado oils available in the US, which is one of the largest consuming countries in the world (Altendorf, 2019).

Here we present an analysis of the quality and purity of avocado oils available in the US market with the goal of starting a database to support standards development for this industry. Twenty-two samples were collected from six grocery stores (14 samples) and two online sources (eight samples), efforts were made to cover all the major brands and types of oil (extra virgin/unrefined and refined). Oil quality was determined using free fatty acidity (FFA), peroxide value (PV), and specific extinction in ultraviolet (UV) absorbances in addition to

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**Table 1**

Sample information for the oils used in this study.

Sample Code	Purchasing Method	Expiration Date (month-year)	Product Origin	Cost/fl oz (\$)	Packaging Type
EV1	Online	Oct-21	California	2.23	Dark glass
EV2	In store	Jun-21	California	1.29	Dark glass
EV3	In store	Feb-21	Mexico	0.65	Dark glass
EV4	In store	Sep-20	California	1.53	Dark glass
EV5	Online	Jul-21	California	1.57	Dark glass
EV6	Online	NA	Brazil	0.49	Clear plastic
EV7	Online	Jun-21	California	2.35	Dark glass
R1	Online	Jun-21	Spain or Mexico	0.44	Dark plastic
R2	In store	Aug-20	Mexico	0.74	Dark glass
R3	In store	Nov-20	Mexico	0.43	Dark glass
R4	Online	Dec-20	Mexico	0.35	Clear plastic
R5	In store	May-20	Mexico	0.25	Dark plastic
R6	In store	Jul-20	Mexico	0.77	Dark glass
R7	Online	Dec-19	Mexico	0.80	Dark glass
R8	In store	Apr-21	Mexico	1.44	Clear glass
R9	In store	Apr-21	Mexico, USA, or Spain	0.29	Clear plastic
U1	In store	NA	Mexico	0.29	Dark plastic
U2	In store	Apr-21	Mexico, USA, or Spain	0.66	Tin bottle
U3	In store	Mar-21	Mexico, USA, or Spain	0.71	Tin bottle
U4	In store	May-21	Mexico	0.47	Dark glass
U5	In store	Jun-21	Mexico	0.79	Dark glass
U6	Online	Feb-21	Mexico	0.34	Clear plastic

chlorophyll and tocopherol content. The authenticity of the oils was assessed using the fatty acids, sterols, and triacylglycerols (TAG) profiles. This study aimed to better understand the quality and purity of avocado oils available in the US and to demonstrate that there is an urgent need for standards in this industry.

## 2. Materials and methods

### 2.1. Avocado oil samples

A total of 22 avocado samples consisting of both extra virgin and refined oils were collected from six grocery stores (14 samples) and two online sources (eight samples). Each oil sample was wrapped in aluminum foil and stored in the dark at 20 °C. Samples were purged with nitrogen after each opening. Table 1 contains information such as purchasing method, expiration date, product origin, cost and packaging type for each oil. Samples were separated into three groups according to their label. Extra virgin oil was coded as “EV” in front of the sample number, refined avocado oil as “R”, and unspecified oils “U”. The unspecified oils were samples that either did not specify the type of avocado oil or, samples that had unclear and ambiguous labels on the bottle.

### 2.2. Quality parameters

FFA, PV, UV specific extinction at 232 nm, 270 nm, and ΔK were determined using AOCS methods Ca 5a-40 (09), Cd 8b-90 (09), and Ch 5-91 (09) (American Oil Chemist's Society, 1998), respectively.

### 2.3. Minor components

Chlorophylls were determined according to AOCS method Cc 13d-55 (09) (American Oil Chemist's Society, 1998). Tocopherols were determined according to Gimeno, Castellote, Lamuela-Raventós, de la Torre, and López-Sabater (2000) with some modifications. Oil (40 µL) and hexane (160 µL) were briefly vortexed. The internal standard, α-tocopheryl acetate (purity 98%, Fisher Scientific Company LLC, USA) in ethanol at a concentration of 300 µg/mL, was then added in addition to 600 µL of methanol. The sample was vortexed for 1 min and centrifuged (5000 rpm, 5 min, Beckman GS-15R). Samples were stored at −20 °C for 2 h to allow oil to separate from the organic phase. The organic extract was filtered (0.45 µm, nylon). Analysis was performed on an

Agilent 1290 Infinity II LC system with a diode-array detector using an Agilent ZORBAX Eclipse Plus C18 column (3.5 µm, 3 × 100 mm). The mobile phase was methanol:water (96:4), isocratic. A 20 µL injection volume and flow rate of 1.0 mL min<sup>−1</sup> were used giving a total run time was 12 min. DAD signal was recorded at 292 nm. All solvents used above were HPLC grade, from Fisher Scientific LLC, USA. Standards α-tocopherol (>96%), and α-tocopheryl acetate (98%) were purchased from Fisher Scientific LLC, USA. Analytical grade standards δ-tocopherol and γ-tocopherol were purchased from MilliporeSigma, USA.

### 2.4. Purity parameters

The IOC official method for the determination of the fatty acid methyl esters by gas chromatography (COI/T.20/Doc. No 33/Rev.1, 2017) was used for fatty acid profile analysis (International Olive Council, 2017). The GC-FID analysis was conducted on an Agilent 7890A GC (Agilent Technologies, USA). A 20 m × 180 µm × 0.20 µm DB-23 capillary column (Agilent Technologies, USA) was used to achieve the separation of individual fatty acids. The injection volume was 1.0 µL and helium, ultra-high purity, Airgas, USA was used as a carrier gas at a flow rate of 1 mL min<sup>−1</sup>. The injector temperature was held at 250 °C at a split ratio of 50. The GC oven program was initially held at 80 °C for 0.5 min; then ramped at 65 °C min<sup>−1</sup> to 175 °C, followed by a ramp of at 10 °C min<sup>−1</sup> to 185 °C, which was held for 0.5 min. The last ramp was at 7 °C min<sup>−1</sup> to 230 °C and held for 5 min, giving a total run time of 14.89 min. The FID temperature was 260 °C. The detector gas consisted of hydrogen, ultra-high purity, Praxair, USA (flow rate: 40 mL min<sup>−1</sup>), air, specialty grade zero air, Praxair, USA, (flow rate: 400 mL min<sup>−1</sup>), and helium, ultra-high purity, Airgas, USA make up gas (flow rate: 25 mL min<sup>−1</sup>). Peak identification was performed using a FAME C8–C22, certified reference material, TraceCERT, MilliporeSigma, USA.

The IOC official method for the determination of the composition and content of sterols (COI/T.20/Doc. No 30/Rev.1, 2013) was used with modifications (International Olive Council, 2013). The unsaponifiable fraction was prepared by drying 0.5 mL of internal standard 0.2% α-cholestanol, analytical grade standard, MilliporeSigma, USA, ethyl acetate solution under nitrogen before adding 50 mL of 2 mol L<sup>−1</sup> ethanolic potassium hydroxide, >85%, Fisher Scientific LLC, USA, to 5 g of the avocado oil sample. The mixture was heated to gentle boiling and kept under reflux for 20 min. The organic/aqueous mixture was extracted three times, 200 mL ethyl ether in total, washed with DI

water, dried with anhydrous sodium sulfate, >99%, Fisher Scientific LLC, USA, evaporated to dryness, and further dried in an oven. The sterols were separated from the other unsaponifiable fractions on a silica gel 60F<sub>254</sub>-coated aluminum-backed thin-layer chromatography (TLC) sheet (MilliporeSigma, USA) with hexane/ethyl ether (60:40, v/v). The sterols band was made visible by spraying the plate with 0.2% 2,7-dichlorofluorescein, ~90% (TLC), MilliporeSigma, USA, ethanolic solution and was then dissolved in 10 mL hot ethyl acetate and 30 mL ethyl ether and evaporated to dryness. All solvents used above were of HPLC grade from Fisher Scientific LLC, USA. Finally, 300  $\mu$ L of the silylation reagent (pyridine, >99%, Fisher Scientific LLC, USA/hexamethyl disilazane, >99%, MilliporeSigma, USA/trimethylchlorosilane, >99%, MilliporeSigma, USA, 9:3:1, v/v/v) was added to prepare the trimethylsilyl ethers for GC injection. The GC-FID analysis was conducted on an Agilent 7890A GC (Agilent Technologies, USA). A 30 m  $\times$  0.25 mm  $\times$  0.25  $\mu$ m DB-5 capillary column (Agilent Technologies, USA) was used with an injection volume of 1.0  $\mu$ L and helium, ultra-high purity, Airgas, USA, as the carrier gas at a flow rate of 1.2 mL min<sup>-1</sup>. The injector temperature was held at 280 °C at a split ratio of 25. The GC oven program was held isothermally at 150 °C for 8 min; then ramped at 20 °C min<sup>-1</sup> to 290 °C and held for 20 min to obtain a total run time of 37.33 min. The FID temperature was 300 °C. The detector gas consisted of hydrogen, ultra-high purity, Praxair, USA (flow rate: 30 mL min<sup>-1</sup>), air, specialty grade zero air, Praxair, USA (flow rate: 400 mL min<sup>-1</sup>), and helium, ultra-high purity, Airgas, USA, make up gas (flow rate: 25 mL min<sup>-1</sup>). Peak identification was carried out with standards campesterol (65%), stigmasterol (95%),  $\beta$ -sitosterol (95%), each from MilliporeSigma, USA and by comparing the generated chromatograms against the sample chromatograms provided in the IOC official method and their relative retention times while the quantification was performed using the peak area and concentration of the internal standard.

TAGs were separated and analyzed using the method described in Green et al. (2020). In brief, each oil was diluted to a final concentrate of 1% with chloroform and then analyzed with the Vanquish™ Flex UHPLC-CAD system (Thermo Fisher Scientific, Waltham, MA, USA). Analytes were separated on a Thermo Scientific™ Accucore™ C18 column (100 mm  $\times$  2.1 mm; 2.6  $\mu$ m). The injection volume was 1  $\mu$ L and the flow rate was 0.5 mL min<sup>-1</sup>. Mobile phase A was acetonitrile and mobile phase B was isopropanol using the solvent gradient conditions: start, 10% B; 2 min, 10% B; 25 min, 40% B; 30 min, 60% B; 35 min, 90% B; 40 min, 50% B and 45 min 10% B. All solvents were HPLC grade from Fisher Scientific LLC, USA.

## 2.5. Statistical analysis

Statistical analysis was accomplished using Originlab Corporation software version “OriginPro 2016 Sr2.” This program was used to run PCA on all samples analyzed with the UHPLC-CAD. Principal component scores were computed by Originlab.

## 3. Results and discussion

### 3.1. Quality parameters

Free fatty acids in the oil are caused by lipolysis where the fatty acids are separated from the TAG and are commonly used as a measurement for oil quality (CODEX, 2017; Woolf et al., 2009). The free fatty acid content of the oils is summarized in Fig. 1a. Overall, samples labeled as “extra virgin” had higher free fatty acidity than “refined” which is expected as the refining processes remove free fatty acids. The unspecified avocado oils had similar values to the refined, aside from U2 and U3, which had an FFA of 0.59% and 0.97%, respectively. Woolf et al. (2009) proposed the refined avocado oil should have values that are less than 0.1% FFA while Weran and Neman et al. (1987) saw about 0.55% FFA for refined oils (Weran & Neeman, 1987; Woolf

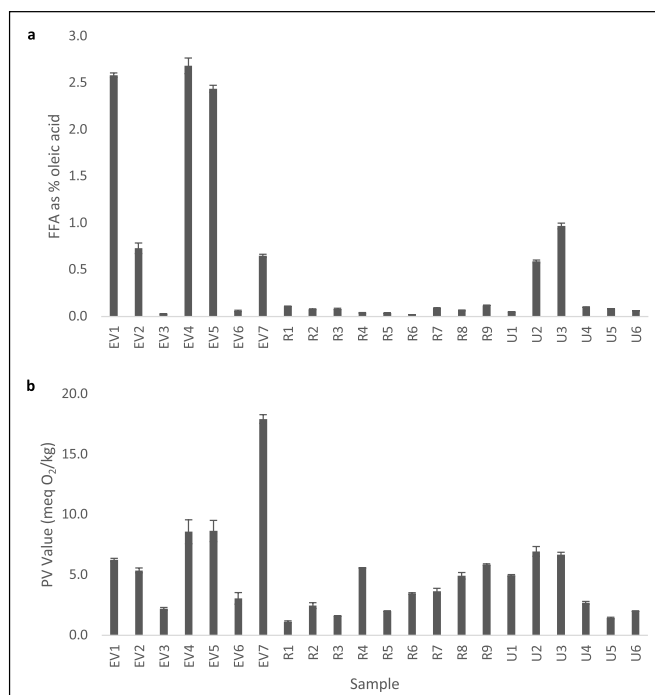
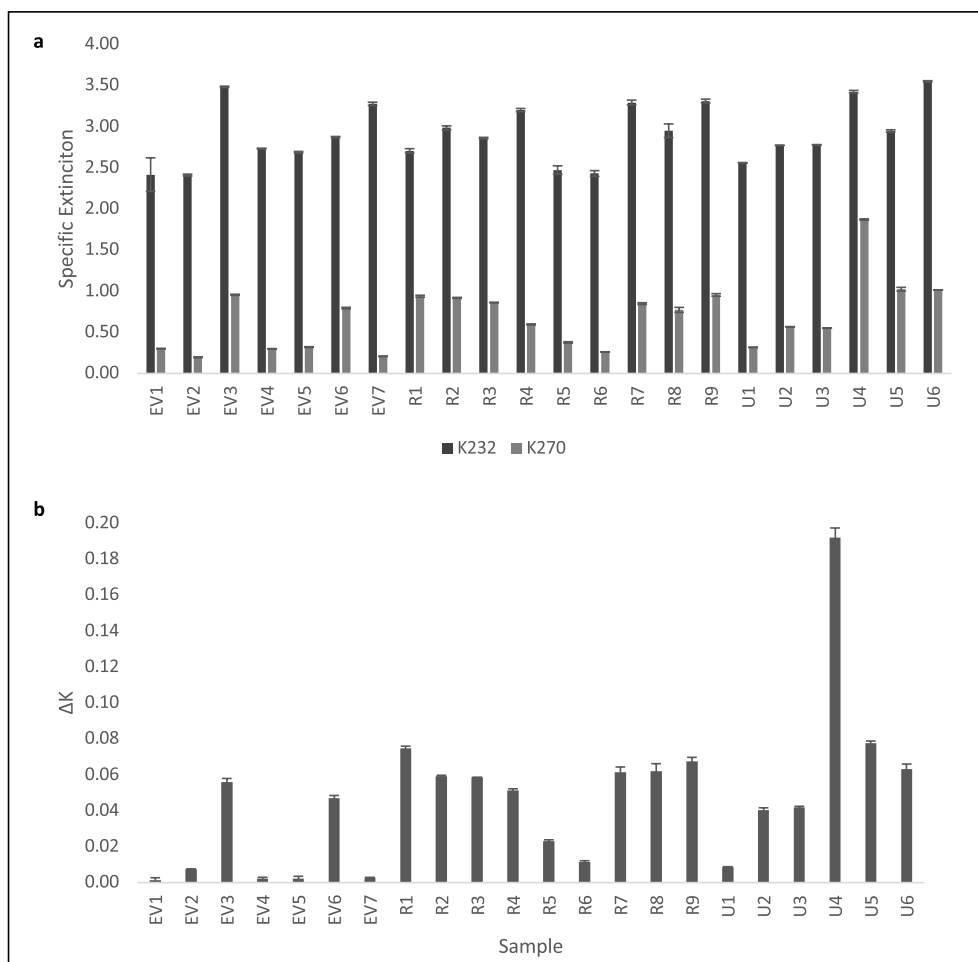


Fig. 1. (a) Free fatty acid content reported as % oleic fatty acid. (b) Peroxide value expressed in meq O<sub>2</sub>/kg. Each bar is an average of triplicate measurements and error bars are calculated using the standard error of the mean (SEM). EV stands for extra virgin, R for refined, and U for unspecified avocado oil.

et al., 2009). The refined oils in this study were all at or under 0.1%. Samples labeled as “extra virgin” had an FFA range of 0.03–2.69%, with an overall average of 1.31%. Commercial samples labeled as “virgin” analyzed in Flores et al. (2014) had FFA values ranging from 0.45 to 0.56%, while avocado oils made in-house in literature range from 0.12 to 2.84% (Bora, Narain, Rocha, & Queiroz Paulo, 2001; Krumreich et al., 2018; Manaf et al., 2018; Ortiz Moreno et al., 2003). The high values seen in this study could indicate use of poor-quality fruit and/or poor handling during processing, particularly for EV1, EV4 and EV5, which had values near 2.5%. Unhealthy fruits that are damaged, bruised, overripe, insect infested; prolonged time between harvest and processing; overheating during processing are all factors that can contribute to a rise in FFA (Woolf et al., 2009).

Peroxides are the primary oxidation products formed when an oil is exposed to oxygen and produce undesirable flavors and odors. The peroxide value results are shown in Fig. 1b. Although trends within the three sample groups are less obvious than with the FFA results, overall, the refined oils had the lowest PV values averaging at 3.42 meq O<sub>2</sub>/kg. The unspecified samples had a slightly higher average (4.13 meq O<sub>2</sub>/kg); extra virgin samples were the highest at 7.4 meq O<sub>2</sub>/kg. As with FFA, the refining process removes peroxides, therefore, lower values are expected for refined oils than those labeled extra virgin. However, many of the refined oils in this study still have notably high PV values. Woolf et al. (2009) proposed 0.5 meq O<sub>2</sub>/kg to be the upper limit for PV in refined avocado oils and standards proposed by Mexico for CODEX cap the acceptable PV at 2 meq O<sub>2</sub>/kg. All of the oils except for R1, R3, and R5 were above these limits (CODEX, 2017; Woolf et al., 2009).

Table 1 contains sample information including purchasing method (in store or online), expiration date, product origin, cost and packaging type for each oil. Interestingly, the three refined oils with the highest PV values (R4, R8, and R9) were stored in clear instead of tinted packaging, which is not protective against photooxidation. Another factor that can contribute high PV values is storage time. The closer an oil is to the best by date on the bottle, the more likely it has had a long storage time. In this study, however, no correlation was found between



**Fig. 2.** (a) Values for the primary oxidation products (K232) and secondary oxidation products (K270) in each oil. (b) Values for  $\Delta K$ . Bars are an average of triplicate measurements and error bars show SEM. EV stands for extra virgin, R for refined, and U for unspecified avocado oil.

the expiration date on the bottle and the PV values and all the samples were tested before reaching the expiration date. Literature values range from 1.4 to 12.74 meq  $O_2$ /kg for lab-made avocado oil samples (Bora et al., 2001; Elez-Martinez et al., 2005; Jorge, Polachini, Dias, Jorge, & Telis-Romero, 2015; Krumreich et al., 2018; Manaf et al., 2018; Ortiz Moreno et al., 2003). A study looking at two commercial virgin avocado samples in Chile, storage time unknown, saw higher PV values of 8 meq  $O_2$ /kg and 12.95 meq  $O_2$ /kg (Flores et al., 2014). All of the samples tested in this study were in those ranges, aside from EV7, at 17.9 meq  $O_2$ /kg. Coincidentally, EV7 was the most expensive sample (\$2.35/fl oz) out of the 22 samples purchased for this study.

$K_{232}$  is another measure of the primary oxidation products present in an oil while  $K_{270}$  measures secondary oxidation products. Fig. 2a shows the  $K_{232}$  values range from a low of 1.4 for sample R6 and EV1 to a high of 3.5 for sample U6. These ranges are comparable to values observed in the limited studies that have measured the specific extinction in UV in avocado oils. Ramírez-Anaya et al. (2018) saw  $K_{232}$  values of 1.8–2.8 for centrifuge extracted oil at different malaxation temperatures (Ramírez-Anaya et al., 2018). Another study looking at commercial oils in Chile saw  $K_{232}$  values in the range of 3.16–4.19 (Flores et al., 2014). It is likely the increase of primary oxidation products seen in commercial samples from both this study and Flores et al. (2014) compared to the values seen in Ramírez-Anaya et al. (2018) are because long storage time results in an increase of autoxidation.

Refined oils have a higher  $K_{270}$  because refining processes create conjugated trienes, which absorb at about 270 nm. Storage time can also increase  $K_{270}$  in avocado oils; Elez-Martinez, Soliva-Fortuny,

Gorinstein, & Martin-Belloso (2005) demonstrated that a fresh sample had a value of 0.4, which increased to 1.6 after 24 weeks (Elez-Martinez et al., 2005). In this study, the  $K_{270}$  was higher for many of the refined (average 0.725) and the unspecified oils (average 0.865) compared to the 0.459 average of the extra virgin samples. No correlation was seen between the expiration dates and  $K_{270}$  values. There was one unspecified oil, U4, with a particularly high  $K_{270}$  value of 1.84, which could indicate poor quality or harsh refining processes. When looking at the extra virgin samples EV3 and EV6 had higher  $K_{270}$  than the rest of the samples in this group. However, a  $K_{270}$  range of approximately 0.1–0.8 was seen in fresh in-house made oils under varying malaxation conditions (Ramírez-Anaya et al., 2018). This range was also seen in a study that analyzed commercial oils labeled as virgin (best-by date unknown), and is similar to the extra virgin oils in this study (0.16–0.77) (Flores et al., 2014).

The  $\Delta K$  value can help distinguish virgin or extra virgin oil from one that is refined. The difference between a poor-quality virgin or extra virgin oil and one adulterated with refined oil can often be seen using  $\Delta K$  (Vossen, 2007). Fig. 2b summarizes the  $\Delta K$  values for the oils in this study. To the best of our knowledge, this is the first report of  $\Delta K$  values for avocado oil and we are therefore unable to compare values in this study with other literature. In the standards for olive oil from the International Olive Council, extra virgin olive oil must have a  $\Delta K$  below 0.01 (Vossen, 2007). As anticipated, all of the refined oils are either at or above this limit as are all of the unspecified avocado oils with U1 having the lowest value of 0.01. U4 has gone under significant refining, with a value of nearly 0.2. For the extra virgin samples EV1, EV2, EV4,



EV5, and EV7 are all under the extra virgin olive oil limit of 0.01. These are also the same samples that had a low  $K_{270}$ . This indicates it is likely that these oils are not adulterated with refined oils; however, some are of poor quality as they had high FFA and PV values. Interestingly, EV3 and EV6 which had low FFA and PV values and seemed to be the highest quality of the extra virgin samples had higher  $K_{270}$  and notably high  $\Delta K$  values of 0.056 and 0.047, respectively compared to the other extra virgin samples. This indicates that it is possible that these two samples are refined or are blended with refined oils; the  $\Delta K$  values for these two samples are still within the standard for refined olive oils, which must be below 0.16 (CODEX, 2017). In addition, the prices of these two samples were significantly lower than other extra virgin samples and more comparable with the refined oils.

### 3.2. Minor components

Chlorophyll pigments are what give extra virgin avocado oil its classic green color. In addition to the extra virgin labeled samples, three unspecified oils (U2, U3, and U6) were also tested as they appeared light green in color unlike the other refined oils and unspecified oils, which were light, pale yellow. The chlorophyll content ranged from 6.62 mg/kg to 98.8 mg/kg as shown in Fig. 3. EV1, EV2, EV4, EV5, and EV7 contained ~95 mg/kg chlorophyll; these oils were noticeably dark green in appearance. The chlorophyll content seen in literature ranges greatly from 1.0 mg/kg to 69.8 mg/kg (Ashton et al., 2006; Jorge et al., 2015; Krumreich et al., 2018; Werman & Neeman, 1987; Wong et al., 2011). The inclusion of skin during processing could be responsible for the high values seen in this study. However, the values seen in Wong et al. (2011) are lower than those seen in this study and in Ashton et al., 2006, which saw a chlorophyll content of to 214 mg/kg from the skin (Ashton et al., 2006; Wong et al., 2011). These variations are not unusual as the cultivar and ripeness of the fruit, extraction method, storage can all greatly impact the amount of chlorophyll in the oils. It's important to note that EV3 and EV6, which had the lowest chlorophyll content, were also the same oils that had low FFA and PV but high  $\Delta K$  and  $K_{270}$ . This also supports the hypothesis that these oils are either refined or blended with oils that are refined.

There are eight compounds that make up vitamin E content, four

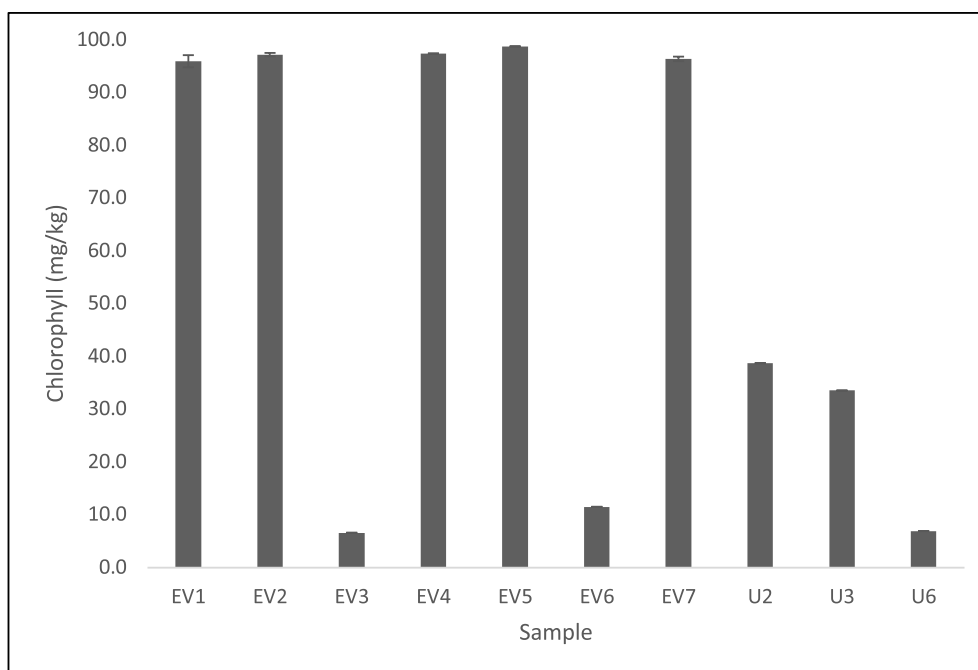
**Table 2**

Individual and total tocopherol content, expressed in mg/kg, for each avocado oil.

	$\alpha$ -Tocopherol	$\gamma + \beta$ -Tocopherol	$\delta$ -Tocopherol	Total tocopherols
EV1	155.2 $\pm$ 11.8 <sup>def</sup>	ND	ND	155.2 <sup>efghi</sup>
EV2	116.0 $\pm$ 4 <sup>gh</sup>	ND	ND	116.0 <sup>ghi</sup>
EV3	87.3 $\pm$ 3.2 <sup>hi</sup>	412.5 $\pm$ 55.4 <sup>b</sup>	145.6 $\pm$ 5.7 <sup>c</sup>	645.4 <sup>b</sup>
EV4	120.7 $\pm$ 4 <sup>efgh</sup>	ND	ND	120.7 <sup>ghi</sup>
EV5	143.3 $\pm$ 1.5 <sup>efg</sup>	ND	ND	143.3 <sup>fghi</sup>
EV6	95.9 $\pm$ 0.5 <sup>ghi</sup>	581.3 $\pm$ 67.1 <sup>a</sup>	229 $\pm$ 9.7 <sup>a</sup>	906.2 <sup>a</sup>
EV7	140.9 $\pm$ 11.9 <sup>efg</sup>	ND	ND	140.9 <sup>fghi</sup>
R1	396.7 $\pm$ 8.7 <sup>a</sup>	108.8 $\pm$ 4.7 <sup>cd</sup>	ND	505.5 <sup>c</sup>
R2	178.2 $\pm$ 2.9 <sup>cde</sup>	ND	ND	178.2 <sup>efgh</sup>
R3	194.2 $\pm$ 7.6 <sup>cd</sup>	102.6 $\pm$ 21.3 <sup>cd</sup>	ND	296.8 <sup>de</sup>
R4	34.0 $\pm$ 1.9 <sup>i</sup>	ND	ND	34.0 <sup>i</sup>
R5	116.9 $\pm$ 2.6 <sup>fgh</sup>	ND	ND	116.9 <sup>ghi</sup>
R6	194.7 $\pm$ 13.1 <sup>cd</sup>	ND	ND	194.7 <sup>efg</sup>
R7	209.3 $\pm$ 12.2 <sup>c</sup>	ND	ND	209.3 <sup>efg</sup>
R8	276.8 $\pm$ 15.3 <sup>b</sup>	ND	ND	276.8 <sup>ef</sup>
R9	49.9 $\pm$ 6.7 <sup>ij</sup>	ND	ND	49.9 <sup>hi</sup>
U1	156.8 $\pm$ 6.2 <sup>def</sup>	ND	ND	156.8 <sup>efghi</sup>
U2	52.2 $\pm$ 0.2 <sup>ij</sup>	42.4 $\pm$ 1.4 <sup>cd</sup>	ND	94.6 <sup>ghi</sup>
U3	60.1 $\pm$ 9.3 <sup>ij</sup>	41.5 $\pm$ 5.4 <sup>cd</sup>	ND	101.6 <sup>ghi</sup>
U4	317.6 $\pm$ 20.9 <sup>b</sup>	106.8 $\pm$ 5.3 <sup>cd</sup>	ND	424.4 <sup>cd</sup>
U5	388.0 $\pm$ 12.7 <sup>a</sup>	129 $\pm$ 5.2 <sup>c</sup>	ND	517.0 <sup>c</sup>
U6	91.1 $\pm$ 0.2 <sup>hi</sup>	440 $\pm$ 48.1 <sup>b</sup>	161.8 $\pm$ 6.6 <sup>b</sup>	692.9 <sup>b</sup>

ND = not detected. Data shown as the average of triplicate measurements plus minus standard error of the mean (mean  $\pm$  SEM, n = 3). Different letters (a, b, c, etc.) in each column indicate significant differences calculated using Tukey test.

tocopherols ( $\alpha$ -tocopherol,  $\beta$ -tocopherol,  $\gamma$ -tocopherol,  $\delta$ -tocopherol) and four tocotrienols. In this study, the four tocopherol compounds were quantified with beta and gamma values summed together (Table 2). Woolf et al. (2009) proposed that the tocopherol content in extra virgin avocado oil should be between 70 and 190 mg/kg (Woolf et al., 2009). Refined oils were not included in this range, as tocopherols are largely removed in the refining process. For all but three samples (EV3, EV6 and U6) in this study, alpha tocopherol was the highest concentration, followed by gamma, then delta which is consistent with literature (Fernandes et al., 2018; Madawalaa, Kochharb, &



**Fig. 3.** Total chlorophyll content determined by AOCS official method Cc 13d-55. Measurements are done in triplicate with error bars indicating SEM. EV stands for extra virgin, R for refined, and U for unspecified avocado oil.

Duttaa, 2012; Manaf et al., 2018). However, the varietal can significantly impact the tocopherol content, for the Bacon avocado variety gamma tocopherol is higher than alpha (Fernandes et al., 2018). The lowest total tocopherol contents in this study were seen in R4 (34.0 mg/kg) and R9 (49.9 mg/kg). This study shows multiple samples (EV3, EV6, R1, U4, U5, U6) had total tocopherol contents over 400 mg/kg, which is interesting as the highest documented total tocopherol content in literature, to our knowledge, is 282 mg/kg (Corzzini et al., 2017). In particular, there are three samples with a notably high total tocopherol content, EV3, EV6 and U6 at 645.4 mg/kg, 906.2 mg/kg, and 692.9 mg/kg, respectively. These samples had significantly higher levels of gamma and delta tocopherols compared to the other samples in this study and to values seen in literature for avocado oils. A study that reported on the tocopherol content in fruits and vegetables (Chun, Lee, Ye, Exler, & Eitenmiller, 2006), showed soybean oil has similar tocopherol levels and distributions to those seen in EV3, EV6 and U6, therefore, it is possible these samples contain soybean or had soybean tocopherols added after processing for preservation.

### 3.3. Purity parameters

Fatty acid profile is commonly used as a part of purity parameters to determine if an oil is adulterated. Table 3 shows the fatty acid profiles of all the samples which are consistent with literature with the exception of EV3, EV6 and U6. These three oils had a linolenic acid (C18:3) values of 8.2–9.8%, while one of the highest values seen in literature was 3.19% in Hass variety (Tan et al., 2017). These oils also had a linoleic acid (C18:2) content of ~55%, substantially higher than seen in the other avocado oils in this study and from literature values, which were approximately 20% (Manaf et al., 2018; Tan et al., 2017). These oils also had high stearic acid (C18:0); low oleic (C18:1) and palmitic (C16:0) acids and their values for the fatty acid profile fit in the parameters for soybean oils from the CODEX standards for named vegetable oils (CODEX, 2017). The other oils in this study all had values comparable to literature with the exception of stearic acid (C18:0), which is higher in R1, R2, R3, R7, R8, U1, U4, and U5 than has been seen previously in literature (Berasategi, Barriuso, Ansorena, & Astiasarán, 2012; Bora et al., 2001; Fernandes et al., 2018; Forero-Doria, García, Vergara, & Guzman, 2017; Noorzyanna, Marikkar, Mustafa, & Mat Sahri, 2017; Ortiz Moreno et al., 2003; Woolf et al., 2009). Samples R1, U4 and U5 also had lower palmitoleic acid (C16:1) compared to what

has been reported in literature (Berasategi et al., 2012; Bora et al., 2001; Fernandes et al., 2018; Forero-Doria et al., 2017; Ortiz Moreno et al., 2003; Ozdemir & Topuz, 2004; Tan et al., 2017). These deviations seen in the fatty acid profile could be a result of economic adulteration, however, due to lack of standards, one cannot easily make such claims. To support the establishment of standards, we need to build a database that includes natural variances such as climate, varietal, and growing region can impact the fatty acid profile of avocado oil.

The sterols profile is another purity parameter often used in conjunction with the fatty acid profile. Table 4 shows the sterols in all the samples. Samples EV3, EV6, and U6 had lower value of  $\beta$ -sitosterol of ~55% and higher values of campesterol and stigmasterol of ~20% and ~15%, respectively, which matched the sterols profile of soybean oil according to the CODEX standards. All other oils had values comparable to what has typically been seen in literature (Fernandes et al., 2018; Jorge et al., 2015; Madawala et al., 2012) with the exception of R1, U4 and U5. These oils are characterized by slightly higher amounts of campesterol, stigmasterol,  $\Delta$ -7 stigmatsterol and  $\Delta$ -7 avensterol and lower  $\beta$ -sitosterol. However, it has been shown avocado oil can have a  $\beta$ -sitosterol content as low as 73.9 mg/kg (Berasategi et al., 2012) and changes in extraction conditions can increase campesterol to values comparable to those seen in R1, U4, and U5 (Dos Santos et al., 2014). Like with the fatty acid profile results, a standard that accommodates natural variables such as cultivar, fruit maturity, irrigation and extraction methods and discriminates pure avocado oil from adulterated one is needed in order to use sterols as a purity indicator for samples like R1, U4, and U5.

TAG profiles were determined for each oil and plotted using PCA as in Green et al. (2020) (Green et al., 2020). Fig. 4 shows samples EV3, EV6, and U6 are located around the soybean oil cluster indicating they are likely 100% soybean oil and corroborating the fatty acid and sterols profiles. All other avocado samples are in a separate group, close to the olive oils. This is expected as avocado, like olive oil, is high in TAGs containing oleic fatty acid and low in linoleic and linolenic. However, there are three samples R1, U4, and U5 are slightly removed from the other avocado oils in the cluster. These samples also have multiple values for their fatty acids and sterols profiles that are outside the range of 2xSD from pure samples in this study. This could be due to natural variance of the avocado fruits, processing conditions, or economic adulteration with high oleic sunflower or safflower oils. Preliminary analysis using the CODEX standards for vegetable oils suggested that

**Table 3**  
Fatty acid profile expressed as percent of total fatty acids for each avocado oil.

	C14:0	C16:0	C16:1	C18:0	C18:1	C18:2	C18:3	C20:0	C20:1	C22:0	C24:0
EV1	ND	16.5 ± 0.1	6.9 ± 0	0.5 ± 0	55.6 ± 0.1	19.2 ± 0.1	1.2 ± 0	ND	0.1 ± 0.1	ND	ND
EV2	0.1 ± 0	15.6 ± 0	6.5 ± 0	0.5 ± 0	61.0 ± 0	15.2 ± 0	1.0 ± 0	ND	0.2 ± 0	ND	ND
EV3	0.1 ± 0	10.9 ± 0	0.1 ± 0	4.0 ± 0	21.4 ± 0.1	54.4 ± 0.1	8.2 ± 0	0.3 ± 0	0.2 ± 0	0.3 ± 0	0.1 ± 0
EV4	0.1 ± 0	15.5 ± 0	6.4 ± 0	0.5 ± 0	59.3 ± 0.1	17.0 ± 0.1	1.1 ± 0	ND	0.2 ± 0	ND	ND
EV5	0.1 ± 0	15.6 ± 0	6.4 ± 0	0.5 ± 0	58.6 ± 0	17.5 ± 0	1.1 ± 0	ND	0.2 ± 0	ND	ND
EV6	0.1 ± 0	10.4 ± 0	0.1 ± 0	3.8 ± 0	19.7 ± 0.5	55.4 ± 0.4	9.8 ± 0	0.4 ± 0	0.2 ± 0	0.3 ± 0	0.1 ± 0
EV7	ND	16.0 ± 0	6.6 ± 0	0.5 ± 0	62.4 ± 0	13.4 ± 0	0.9 ± 0	ND	0.2 ± 0	ND	ND
R1	ND	10.0 ± 0	1.7 ± 0	2.3 ± 0	69.1 ± 0	15.2 ± 0	0.5 ± 0	0.3 ± 0	0.3 ± 0	0.4 ± 0	0.2 ± 0
R2	ND	14.7 ± 0	5.8 ± 0	1.4 ± 0	64.4 ± 0.1	12.2 ± 0	0.7 ± 0	0.2 ± 0	0.3 ± 0	0.2 ± 0	0.1 ± 0
R3	ND	13.2 ± 0	4.2 ± 0	1.4 ± 0	63.8 ± 0.1	16.0 ± 0.1	0.7 ± 0	0.2 ± 0	0.3 ± 0	0.2 ± 0	0.1 ± 0
R4	ND	15.8 ± 0	6.8 ± 0	0.5 ± 0	63.8 ± 0	12.0 ± 0	0.8 ± 0	ND	0.2 ± 0	ND	ND
R5	ND	15.0 ± 0	6.5 ± 0	0.8 ± 0	63.6 ± 0	12.8 ± 0	0.8 ± 0	0.1 ± 0	0.2 ± 0	0.1 ± 0	ND
R6	ND	17.8 ± 0	8.6 ± 0	0.6 ± 0	61.0 ± 0.1	10.9 ± 0	0.8 ± 0	0.1 ± 0	0.2 ± 0	ND	ND
R7	ND	14.4 ± 0	5.2 ± 0	1.4 ± 0	64.8 ± 0	13.0 ± 0	0.7 ± 0	0.2 ± 0	0.2 ± 0	0.2 ± 0	0.1 ± 0
R8	ND	13.4 ± 0	5.1 ± 0	1.6 ± 0	67.5 ± 0	10.9 ± 0	0.6 ± 0	0.2 ± 0	0.2 ± 0	0.3 ± 0	0.1 ± 0
R9	ND	14.1 ± 0	5.2 ± 0	1.0 ± 0	63.2 ± 0	15.0 ± 0	0.8 ± 0	0.2 ± 0	0.2 ± 0	0.1 ± 0	0.1 ± 0
U1	ND	16.5 ± 0	7.4 ± 0	1.3 ± 0	63.9 ± 0	9.8 ± 0	0.7 ± 0	0.2 ± 0	0.2 ± 0	ND	ND
U2	ND	16.4 ± 0	7.2 ± 0	0.6 ± 0	60.0 ± 0	14.7 ± 0	0.9 ± 0	ND	0.2 ± 0	ND	ND
U3	ND	16.5 ± 0	7.4 ± 0	0.6 ± 0	60.4 ± 0	13.9 ± 0	0.8 ± 0	0.1 ± 0	0.2 ± 0	ND	ND
U4	ND	10.4 ± 0	2.0 ± 0	2.1 ± 0	66.5 ± 0	17.4 ± 0	0.5 ± 0	0.4 ± 0	0.3 ± 0	0.2 ± 0	0.1 ± 0
U5	0.1 ± 0	11.2 ± 0	0.6 ± 0	2.8 ± 0	68.3 ± 0	15.4 ± 0	0.5 ± 0	0.4 ± 0	0.3 ± 0	0.4 ± 0	0.2 ± 0
U6	0.1 ± 0	10.9 ± 0	0.1 ± 0	4.0 ± 0	21.0 ± 0	54.7 ± 0	8.2 ± 0	0.3 ± 0	0.2 ± 0	0.3 ± 0	0.1 ± 0

ND = not detected. Data shown as (mean ± SEM, n = 2).

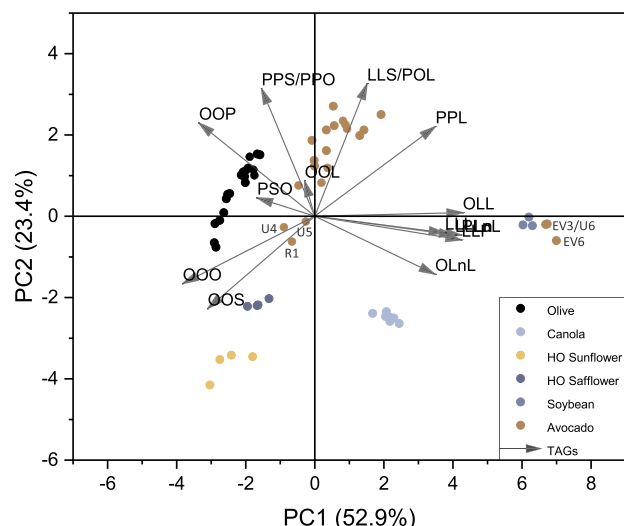


**Table 4**

Sterols profile for each avocado oil expressed as percent total sterols. Total sterols in mg/kg.

	Brassicasterol	Campesterol	Stigmasterol	$\Delta 7$ -campesterol	Clerosterol (II)	$\beta$ -sitosterol (III)	$\Delta 5$ -Avenasterol	$\Delta 7$ -Stigmasterol	$\Delta 7$ -Avenasterol	Total Sterols
EV1	0.4 $\pm$ 0.4	5.5 $\pm$ 0	0.8 $\pm$ 0.2	ND	1.9 $\pm$ 0.1	85.6 $\pm$ 0.5	5.7 $\pm$ 0.3	ND	ND	5955 $\pm$ 110
EV2	ND	5.4 $\pm$ 0.3	ND	ND	1.9 $\pm$ 0.1	86.8 $\pm$ 0.7	5.8 $\pm$ 0.3	ND	ND	4670 $\pm$ 200
EV3	ND	20.3 $\pm$ 0.1	15.8 $\pm$ 0.1	ND	ND	56.3 $\pm$ 0.1	2.7 $\pm$ 0	2.8 $\pm$ 0.2	2.1 $\pm$ 0.3	2601 $\pm$ 75
EV4	ND	5.6 $\pm$ 0.1	0.6 $\pm$ 0	ND	1.8 $\pm$ 0	86 $\pm$ 0.3	6.0 $\pm$ 0.3	ND	ND	5649 $\pm$ 200
EV5	ND	5.8 $\pm$ 0	0.6 $\pm$ 0	ND	1.9 $\pm$ 0	85.4 $\pm$ 0.3	6.3 $\pm$ 0.3	ND	ND	5245 $\pm$ 140
EV6	ND	23.3 $\pm$ 0.1	15 $\pm$ 0.2	ND	ND	55.2 $\pm$ 0.1	3.8 $\pm$ 0.2	1.5 $\pm$ 0.1	1.3 $\pm$ 0.1	3306 $\pm$ 0
EV7	ND	6.3 $\pm$ 0	ND	ND	1.9 $\pm$ 0	86.3 $\pm$ 0.1	5.6 $\pm$ 0.1	ND	ND	4263 $\pm$ 31
R1	ND	8.6 $\pm$ 0.2	4.6 $\pm$ 0.1	ND	0.9 $\pm$ 0	75.6 $\pm$ 0.2	4.5 $\pm$ 0.2	4.3 $\pm$ 0.1	1.4 $\pm$ 0.2	2906 $\pm$ 10
R2	ND	5.7 $\pm$ 0	1.4 $\pm$ 0	ND	1.2 $\pm$ 0	85.7 $\pm$ 0.1	4.6 $\pm$ 0.1	1.5 $\pm$ 0.1	ND	3356 $\pm$ 48
R3	ND	7.6 $\pm$ 0.3	2.2 $\pm$ 0.2	ND	1.3 $\pm$ 0.1	81.4 $\pm$ 1.9	5.2 $\pm$ 0	2.2 $\pm$ 2.2	ND	3362 $\pm$ 56
R4	ND	4.9 $\pm$ 0	0.4 $\pm$ 0	ND	1.4 $\pm$ 0	87.1 $\pm$ 0	5.6 $\pm$ 0.1	ND	ND	3850 $\pm$ 3.0
R5	ND	5.6 $\pm$ 0	0.9 $\pm$ 0	ND	1.3 $\pm$ 0	86.0 $\pm$ 0	5.2 $\pm$ 0	0.5 $\pm$ 0	ND	3926 $\pm$ 14
R6	ND	6.3 $\pm$ 0	0.6 $\pm$ 0	ND	1.5 $\pm$ 0	86.5 $\pm$ 0.1	5.1 $\pm$ 0.1	ND	ND	3553 $\pm$ 25
R7	ND	5.8 $\pm$ 0	1.3 $\pm$ 0	ND	1.2 $\pm$ 0	87 $\pm$ 0.1	4.8 $\pm$ 0.1	ND	ND	3344 $\pm$ 74
R8	ND	6.1 $\pm$ 0.1	2.5 $\pm$ 0	ND	1.3 $\pm$ 0.1	81.1 $\pm$ 0.3	4.6 $\pm$ 0.2	3.4 $\pm$ 0	1.2 $\pm$ 0.1	3168 $\pm$ 170
R9	ND	9.1 $\pm$ 0	2.1 $\pm$ 0	ND	1.4 $\pm$ 0	81.4 $\pm$ 0.1	5.9 $\pm$ 0.1	ND	ND	4125 $\pm$ 73
U1	0.4 $\pm$ 0.4	6.0 $\pm$ 0	0.6 $\pm$ 0.2	ND	1.2 $\pm$ 0	88.4 $\pm$ 0.4	3.5 $\pm$ 0.2	ND	ND	2859 $\pm$ 70
U2	ND	7.7 $\pm$ 0.6	1.1 $\pm$ 0	ND	1.6 $\pm$ 0	83.5 $\pm$ 1.1	6.0 $\pm$ 0.5	ND	ND	4066 $\pm$ 250
U3	ND	6.8 $\pm$ 0.2	1.1 $\pm$ 0	ND	1.6 $\pm$ 0	84.9 $\pm$ 0	5.6 $\pm$ 0.2	ND	ND	4340 $\pm$ 69
U4	ND	10.1 $\pm$ 0.1	3.8 $\pm$ 0.1	0.7 $\pm$ 0	0.9 $\pm$ 0.1	74.7 $\pm$ 0	4.6 $\pm$ 0.2	4.0 $\pm$ 0.2	1.2 $\pm$ 0.1	3341 $\pm$ 95
U5	ND	9.2 $\pm$ 0.1	4.8 $\pm$ 0.1	ND	ND	77 $\pm$ 0.2	3.6 $\pm$ 0.1	4.2 $\pm$ 0.2	1.2 $\pm$ 0.1	3465 $\pm$ 66
U6	ND	20.6 $\pm$ 0.2	16.2 $\pm$ 0.4	ND	ND	56 $\pm$ 0.4	2.5 $\pm$ 0.3	2.8 $\pm$ 0.3	1.8 $\pm$ 0.1	2678 $\pm$ 130

ND = not detected. Data shown as (mean  $\pm$  SEM, n = 2).



**Fig. 4.** TAG profiles plotted using PCA. The six avocado oils that differed from other samples are labeled according to their sample codes. All other avocado oils from this study are labeled as avocado, shown in dark orange. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

50:50 adulteration of avocado oil: high oleic sunflower could yield similar profiles as samples R1, U4, and U5.

#### 4. Conclusions

This study demonstrates, for the first time, there are problems in both quality and purity in the store-bought extra virgin and refined avocado oil. The majority of the samples were of low quality with five of the seven oils labeled as “extra virgin” having high FFA values and six of the nine “refined” oils had high PV. FFA, PV, and specific extinction in UV data demonstrated that these oils have undergone lipolysis and oxidation, respectively. This likely resulted from improper or prolonged storage, using damaged or rotten fruits, or extreme and harsh processing conditions. Extra virgin oils often are more expensive and distinguished from lower grades such as virgin or crude oils using the above quality parameters.

Adulteration with soybean oil was found in two samples labeled as “extra virgin” avocado oil (EV3 and EV6) and one labeled as “pure” avocado oil (U6). Tocopherol, fatty acid, sterols, and TAGs data show this adulteration is occurring at or near 100% for all three samples. This not only is a potential health hazard for consumers but creates unfair competition in the market. EV3 and EV6 cost \$0.65/fl oz and \$0.49/fl oz, compared to the other extra virgin oils, which averaged at \$1.73/fl oz. Authentic extra virgin avocado oils are clearly being outcompeted by this economically motivated adulteration. In the case of samples EV3, EV6, and U6 the adulteration was confirmed in addition to the adulteration percent and adulterant oil. However, the need for standards is also demonstrated by the samples R1, U4, and U5. The variance seen in their fatty acid, sterols, TAGs, and tocopherols profiles could be due to natural variance of the avocado fruits, processing conditions, or unnaturally, economic adulteration with high oleic sunflower or safflower oils. In order to establish fair standards, it is also imperative to know how these parameters change with varietal, harvest time, and processing conditions to determine the appropriate ranges for avocado oil, ensuring authentic products are not flagged incorrectly. This study gives a timely overview of the quality and authenticity of the avocado oils available on the US market and a call to action for the standards establishment.

#### Author contributions

S.W. and H.G. prepared the study. H.G. performed the experiments and both contributed to the writing.

#### CRedit authorship contribution statement

**Hilary S. Green:** Investigation, Data curation, Writing - original draft, Writing - review & editing. **Selina C. Wang:** Conceptualization, Supervision, Project administration, Funding acquisition, Writing - review & editing.

#### Declaration of competing interest

The authors have no competing interests to declare.

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# EXHIBIT 5

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# Why your avocado oil may be fake and contain other cheap oils

Scientists say adulteration is rampant in the avocado oil industry, and many people are being misled by some of the nation's largest retail chains.

August 27, 2024

11 min



467



By [Anahad O'Connor](#) and [Aaron Steckelberg](#)

Avocado oil is a rising star in the culinary world. It's a heart-healthy cooking oil with a mild flavor that appeals to health-conscious consumers.

But scientists say that adulteration and mislabeling are rampant in the avocado oil industry, and that many people who believe they're buying pure avocado oil are being misled by some of the nation's largest retail chains.



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Scientists at the University of California at Davis tested avocado oil samples, and have for the first time revealed the names of a dozen retailers who they say sold products labeled as avocado oil that contained cheap seed and vegetable oils, including Walmart, Sam's Club, Kroger and Safeway. The companies didn't respond to requests for




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The researchers found that at least 21 of the products labeled as avocado oil — nearly two-thirds of the 36 bottles they tested— were adulterated, in some cases with other oils that could pose a hazard to people with food sensitivities. The newly released findings are based on tests conducted in 2021 on bottles of store-brand avocado oil purchased from 19 large grocery stores in the United States and Canada.

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Other retailers whose products failed testing said they couldn't verify findings based on bottles of oil produced in 2020 or 2021. Some retailers confirmed they don't do their own testing and instead rely on suppliers and third-party services to verify the purity of the oil.



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Retailers have a “responsibility to make sure that what’s on the label is consistent with the product itself,” said Selina Wang, the scientist who

led the research and an associate food science professor at the University of California at Davis. “Based on our research that’s simply not the case.”

In a statement, the Food and Drug Administration acknowledged that “high value oils” such as avocado oil “are potential targets for economically motivated adulteration.” “The FDA does not comment on specific studies,” an FDA official said, “but evaluates them as part of the body of evidence to further our understanding about a particular issue.”

## How cheap avocado oil is made

Avocado oil is the fastest-growing segment of the edible oils market, with global sales of more than half a billion dollars. The UC-Davis research suggested that low-priced avocado oils were the most likely to be adulterated. Most major retailers do not produce their own avocado oil, and instead buy it from suppliers, bottle it and put their store labels on it.



Much of the avocado oil sold by retailers is “refined,” which means it’s a lower-quality, highly-processed oil that is bleached, deodorized and filtered. (Virgin and extra virgin oils are “unrefined” and typically pressed from high-quality avocados without using heat or chemicals.)

### UNREFINED (less processed)

Generally means no additional refining takes place after the fruit is pressed to extract the oil. Labels will usually include the words **cold-pressed**, **virgin** or **extra virgin**.



Higher-quality,  
ripe avocados

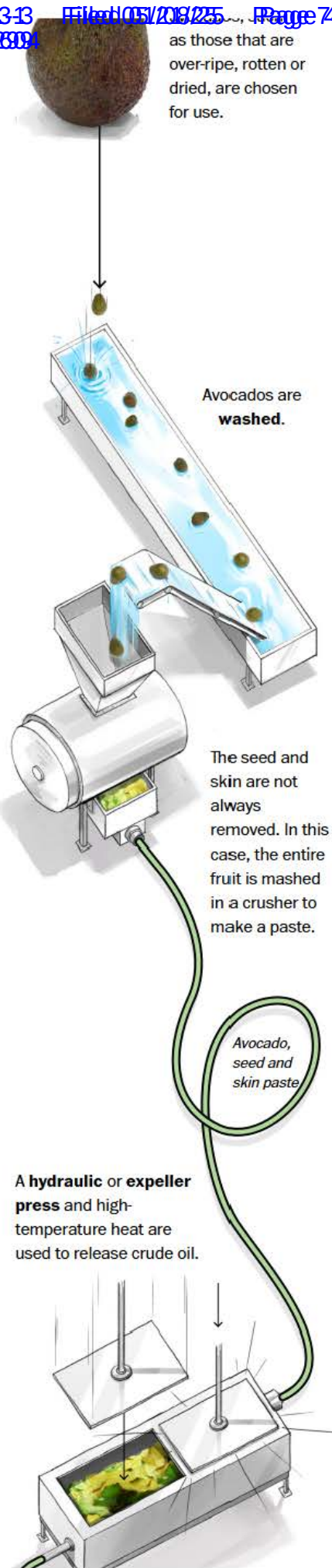
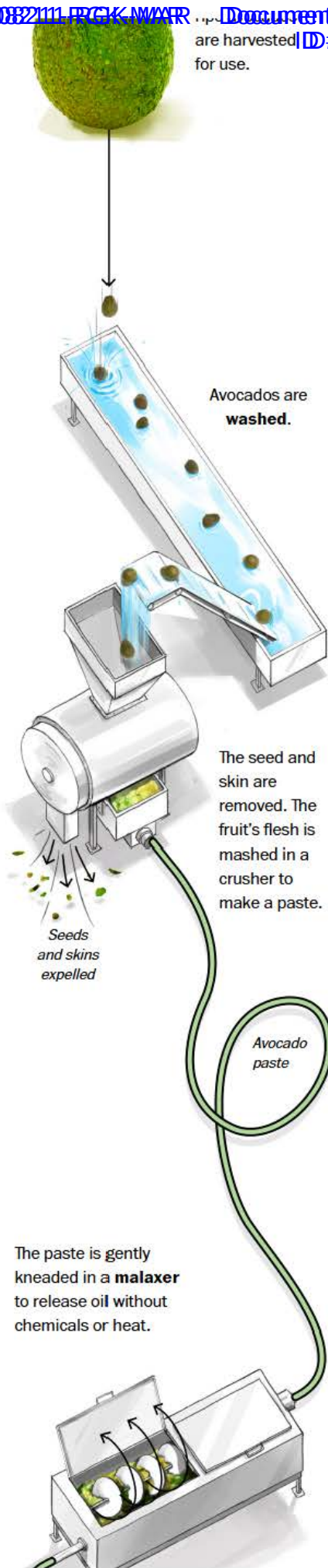
### REFINED (more processed)

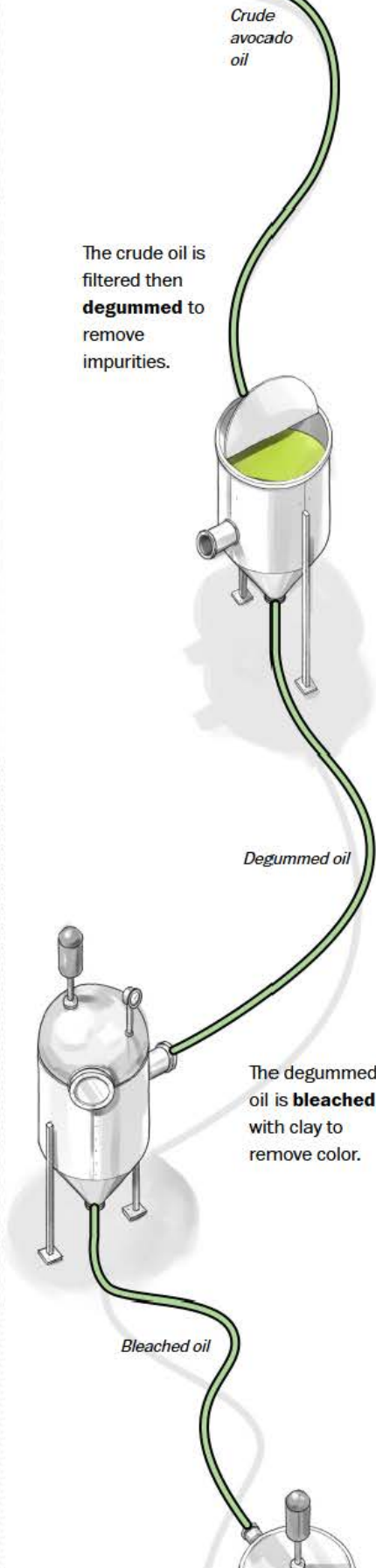
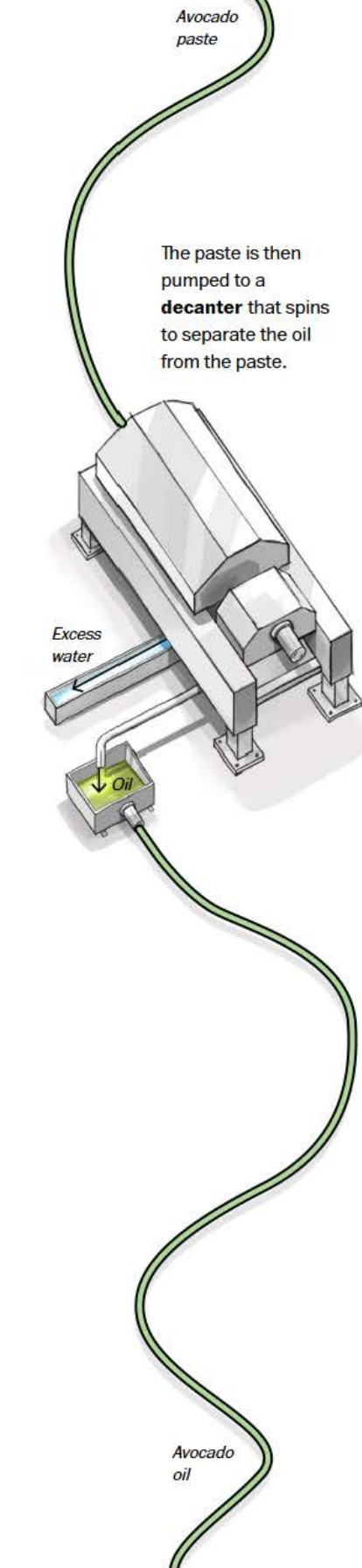
This indicates that additional steps are taken to refine the oil after it is extracted from the fruit. This may include **degumming**, **neutralization**, **bleaching** and/or **deodorization**.

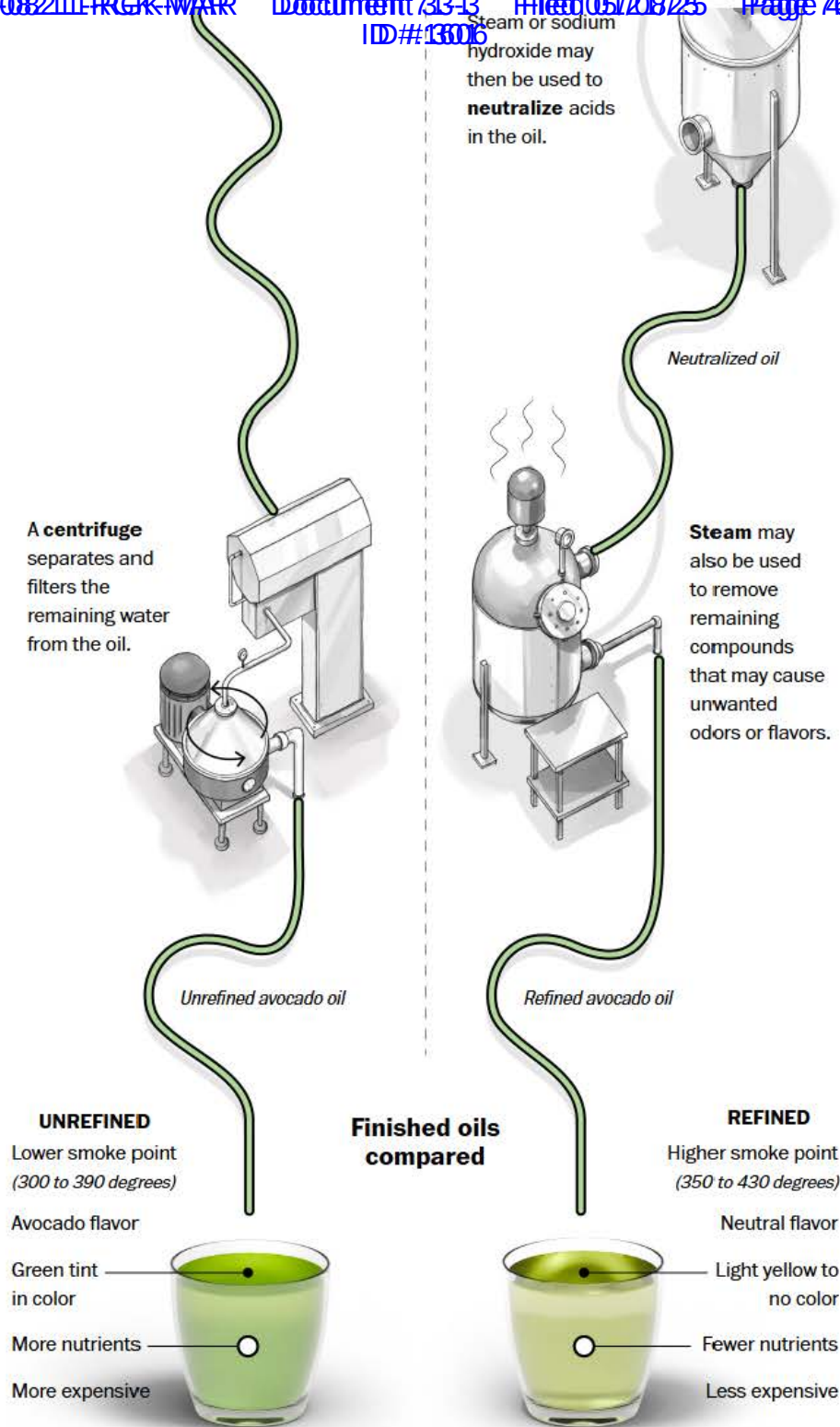


Lower-quality  
avocados such









## Suppliers selling fake avocado oil

The popularity of avocado oil is largely due to the health halo around avocados. Avocado oil is rich in heart-healthy monounsaturated fats, antioxidants, minerals and vitamin E.

Avocado oil is relatively expensive to produce, and retail stores that buy



it from suppliers at unrealistically low prices should have some idea that they're not getting the real thing, Wang said. "If a buyer finds that an oil is quite a bit lower in price compared to others, there's probably a reason for that," she added.



Some suppliers and producers said it's an open secret that adulteration is rampant in the avocado oil industry. Ben Barnard, the founder and chairman of AvoPacific, one of the largest avocado oil producers in North America, said he has seen competitors selling refined avocado oil to retailers for prices so low that it would not be possible for them to make a profit if their avocado oil was real.

"We were getting undercut by more than 50 percent in some cases and kind of being laughed at," Barnard said. "If you just followed the numbers, anyone in the industry could have told you what was going on."

The company said that most of its oil is sold under its own label, AvoPacific. In 2020, UC-Davis tested an AvoPacific oil sold under the brand name "CalPure Extra Virgin Avocado Oil," and it passed their tests.

## The avocado oil brands that failed testing

The avocado oil researchers initially published their findings in a scientific journal last fall without disclosing the names of the adulterated products. But at the request of The Washington Post, the researchers agreed to disclose the names of the brands that failed their tests because adulterated oils can put people with food sensitivities at risk.

The tests showed that six retailers — Walmart, Trader Joe's, Aldi, Metro, Meijer and Kroger — sold bottles labeled as avocado oil that contained high levels of oleic sunflower or safflower oils. These oils are less expensive than avocado oil and have different health and culinary

properties. At Target and Sprouts Farmers Market, the researchers found bottles of store-brand avocado oil that their tests indicated contained canola oil, a less expensive cooking oil.



Researcher Selina Wang, the lead author of the avocado oil study, looks at an oil sample before testing it for purity. (Jyotsna Bhamidipati for The Washington Post)

In some cases, the tests showed that bottles labeled avocado oil contained other oils that could not be identified. The researchers said they found that sunflower, safflower, canola, and soybean oils were the most common adulterants in products labeled as avocado oil. These oils look similar to refined avocado oil but are cheaper to make.

Price was not always a reliable indicator of adulteration. One of the most expensive products included in the study was Stop & Shop's store-brand "extra-virgin" avocado oil, which sells for close to \$9 for an 8.45-ounce bottle, or more than a dollar per ounce. The researchers tested two bottles of the product and found that both contained oils that were neither extra virgin nor avocado oil. It was unclear what type of oil or oils were in the bottles.

Stop & Shop's cold-pressed "Extra Virgin" avocado oil was the only



extra-virgin oil in the study that was found to be adulterated with other oils.

## Retailers dispute the findings

In general, retailers who responded to questions about the adulterated oils said it's impossible for them to verify findings based on bottles of oil tested that were made in 2020 or 2021.

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In a statement, Stop & Shop said that the avocado oil included in the UC-Davis study was procured from a former supplier and that it is no longer available in its stores. "Our current supplier of store brand extra virgin avocado oil has provided a certification that the store brand extra virgin avocado oil is extra virgin avocado oil," the company said. "Stop & Shop continues to work with the current supplier to provide customers with a great product at a great value."

The company would not say who its previous supplier was, but it added that it was incorporating "our own routine testing."

Trader Joe's said in a statement that its suppliers and "certified third-party labs" use industry-standard testing procedures to evaluate their avocado oil for quality and authenticity. "Based on the results of this testing, we believe Trader Joe's Avocado Oil is 100 percent avocado oil," the company said. The company added that it could not retest the batches that were included in the study because the products were no longer sold in its stores.

The avocado oils that were collected for samples and testing. (Jyotsna Bhamidipati for The Washington Post)

A spokesperson for Metro said the results of the UC-Davis study do not match company records that show its avocado oils meet standards. "Additionally, the Canadian Food Inspection Agency tested samples of



November 2023, and it was compliant.”

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A spokesperson for Target said the company requires its manufacturing partners to comply with all federal, state, and local regulations. “While we were unaware of the report’s findings with these products, we will work with our manufacturing partners to evaluate these claims,” the spokesperson said.

A spokesperson for Sprouts Farmers Market said the company “places the utmost importance on the quality, integrity and transparency of our Sprouts Brand products. Our Sprouts Brand avocado oil met required standards for purity when the product was manufactured in 2020.”

Bottles of store-brand avocado oil purchased from Safeway, ShopRite

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A spokesperson for Sprouts Farmers Market said the company “places the utmost importance on the quality, integrity and transparency of our Sprouts Brand products. Our Sprouts Brand avocado oil met required standards for purity when the product was manufactured in 2020.”

Bottles of store-brand avocado oil purchased from Safeway, ShopRite and Sam’s Club were also found to be adulterated with other oils. In a statement, ShopRite said that it was in the process of reviewing the findings and that it had asked its supplier to test lot samples from the avocado oil that was included in the study. “Our vendor has assured us the avocado oil in question is not adulterated,” the company said. “Nevertheless, we will be conducting our own third-party investigation

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Walmart, Sam’s Club, Safeway, Aldi, and Kroger didn’t respond to requests for comment. A spokesperson for Fresh Thyme, the brand that was purchased from Meijer, declined to comment.

Wang at UC-Davis said retailers should not rely solely on certifications from suppliers for products that are at high risk of being adulterated. “Retailers should do their own testing to ensure that the label on the bottle is consistent with the product in the bottle,” she said.

Wang said it was possible in cases where a retailer did its own independent testing that their results might differ from UC-Davis’s test results if different lots were tested or if the retailer used multiple suppliers. “We have observed significant differences in the quality and purity of oil from different lot numbers, even when sourced from the same retailer,” she added.

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“If a buyer finds that an oil is quite a bit lower in price compared to others, there’s probably a reason for that.”

In their study, Wang and her co-author, Hilary S. Green, found that refined avocado oils, particularly those that listed Spain as their country of origin, were the most likely to be adulterated. At least one out of the

— Selina Wang, associate professor  
of Cooperative Extension in the  
Department of Food Science and  
Technology at the University of  
California at Davis

adulterated. At least 19 out of 29  
bottles of refined avocado oil  
included in their study contained  
other oils, and every single one of  
the 11 bottles in the study that

contained oil from Spain was found to be adulterated.

In some cases, the UC-Davis researchers discovered striking variation  
within individual brands.

“If you just followed  
the numbers, anyone  
in the industry could  
have told you what  
was going on.”

— Ben Barnard, founder and  
chairman of AvoPacific

For instance, tests indicated that  
a bottle of Wegmans refined and  
expeller-pressed “Pure Avocado  
Oil” was mixed or substituted  
with a different oil. But when the  
researchers tested a bottle of  
Wegmans “Extra Virgin” avocado  
oil, they found that it contained  
pure avocado oil.

In a statement, Wegmans said that its supplier sends every lot of its  
avocado oil to a third-party lab for analysis. “Product does not leave our  
supplier’s facility until they have the results, and it is confirmed that  
what’s on the label is what’s in the bottle,” the company said. “We also  
occasionally do our own testing to ensure the legitimacy of our  
products.”

The company said that in April, an independent lab tested samples of its  
store-brand avocado oils, purchased from Wegmans’s store shelves, and  
that the samples were found to be free from adulteration.

## Avocado oils that failed testing

### Tested as not pure avocado oil

#### Refined avocado oil

BRAND (STORE)	ORIGIN(S)	NOTES
Great Value (Walmart)	Mexico	High oleic sunflower or safflower oil
Great Value (Walmart)	Mexico	Failed both fatty acid & sterol tests
Great Value (Walmart)	Spain	“Tested impure”
Sprouts	Mexico, South Africa, France	Canola Oil
Sprouts	Mexico, South Africa, France	Canola Oil

#### Refined & expeller pressed

Good & Gather (Target)	Mexico	Tested “no” on both criteria
Wegmans	Mexico	Failed both fatty acid & sterol tests



Good & Gather (Target) Mexico ID # 13013 Canola Oil

#### Cold pressed & refined

Fresh Thyme (Meijer)	Spain	High oleic sunflower or safflower oil
Fresh Thyme (Meijer)	Spain	"Tested impure"
Private Selection (Kroger)	Spain	High oleic sunflower or safflower oil
Private Selection (Kroger)	Spain	"Tested impure"

#### Cold pressed

Bowl and Basket (ShopRite)	Spain	"Tested impure"
Olivari (Sam's Club)	Spain	"Tested impure"
Simply Nature (Aldi)	Spain	High oleic sunflower or safflower oil
Simply Nature (Aldi)	Spain	"Tested impure"

#### Extra Virgin

Stop and Shop	Spain	"Not 100% avocado oil"
Stop and Shop	Spain	"Not 100% avocado oil"

#### Unspecified

Signature Select (Safeway)	Mexico	Failed both fatty acid and sterol tests
Signature Select (Safeway)	Mexico	Failed both fatty acid and sterol tests
Trader Joe's	Mexico	High oleic sunflower or safflower oil

Oils listed above failed purity tests for both the Codex Alimentarius – an international set of standards, guidelines and codes to ensure purity – and the criteria set by researchers.

## Avocado oil brands that passed purity testing

### Tested as pure avocado oil

#### Refined avocado oil

BRAND (STORE)	ORIGIN(S)
Simple Truth (Kroger)	U.S. and Mexico
Simple Truth (Kroger)	U.S. and Mexico

#### Refined and expeller pressed

365 (Whole Foods)	France
365 (Whole Foods)	France
Good & Gather (Target)	South Africa
Good & Gather (Target)	South Africa

#### Virgin

President'sChoice	Mexico
-------------------	--------

#### Extra virgin

President'sChoice	Mexico
Wedmans	Mexico

### Unspecified

Harvest Peak	Mexico
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Oils listed above passed purity tests for both the Codex Alimentarius — an international set of standards, guidelines and codes to ensure purity — and the criteria set by researchers.

## Problems in the edible oil industry

Wang was part of a team that garnered international attention in 2010 for a study that revealed that most imported olive oils labeled “extra virgin” were not extra virgin at all. The findings led to the creation of a California olive oil commission and the adoption of stricter labeling standards.

Wang turned her attention to avocado oil when she heard rumors that some producers were knowingly selling rancid and adulterated oils. She said she had also received messages from people with food allergies who were worried about unknowingly being exposed to food allergens because of adulterated avocado oil.

Wang said the Food and Drug Administration needs to adopt an official “standard of identity” for avocado oil, which would describe in detail the characteristics that an oil must have to be sold as avocado oil. The FDA has established these standards for more than 250 foods, including milk, peanut butter, ketchup, milk chocolate, bread and jam. But avocado oil does not yet have a standard of identity.

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# EXHIBIT 6



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# Evidence-Based Health Benefits of Avocado Oil



Medically reviewed by  
Adrienne Seitz, MS, RD,  
LDN, Nutrition — Written by  
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Updated on November 26,  
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Heart health | Eye benefits | Nutrient absorption | Arthritis relief |

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Avocado oil is delicious, nutritious, and easy to use. It's rich in oleic acid, polyunsaturated fats, carotenoids, and other antioxidant-rich nutrients that are linked to improved heart, skin, and eye health.

Avocado oil is the natural oil pressed from the pulp of an avocado. About 60% of avocado oil consists of heart-healthy oleic acid, a monounsaturated omega-9 fatty acid.

This fatty acid is also the main component of olive oil and is believed to be partly responsible for its health benefits. Additionally, around 12% of avocado oil is saturated fat, and about 13% is polyunsaturated fat.


## Reduces cholesterol and improves heart health

One rat study<sup>®</sup> compared avocado oil to losartan, a blood pressure medication, for 45 days. It found that avocado oil reduced diastolic and systolic blood pressure by 21.2% and 15.5%, respectively, and had similar effects to losartan in reducing blood pressure.

Another rat study found that avocado oil was effective in reducing levels of triglycerides and LDL (bad) cholesterol and did not affect HDL (good) cholesterol.

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While these results are promising, larger human clinical trials are still needed.



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## High in lutein, an antioxidant that has benefits for the eyes

Avocado and its oil are relatively good sources of lutein, a carotenoid and antioxidant that's naturally found in your eyes.

Research has shown that a diet rich in lutein and another carotenoid called zeaxanthin is essential for eye health and may reduce the risk<sup>9</sup> of cataracts and macular degeneration, which are common age-related eye diseases.

Since your body doesn't produce lutein on its own, you must obtain it from your diet. Fortunately, adding avocado and avocado oil to your diet is a great and easy way to support your eye health.

## Enhances the absorption of important nutrients

Some nutrients need to be combined with fat to allow your body to absorb them, such as the fat-soluble<sup>9</sup> vitamins A, D, E, and K.

Adding avocado oil or another type of fat to your meal may help you better absorb these nutrients.

One small study<sup>9</sup> found that adding avocado oil to a salad with carrots, romaine lettuce, and spinach increased the absorption of carotenoids. The increase was substantial — 4.3- to 17.4-fold — when compared with a salad without fat.

Other studies have shown that olive oil, which has a very similar oleic acid content to avocado oil, is highly effective in increasing the bioavailability of carotenoids.

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Therefore, adding avocado oil to a salad, marinade, or other dish may help your body absorb more nutrients.



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## May reduce symptoms of arthritis

Arthritis is a very common disease that involves painful inflammation of the joints. It affects millions<sup>®</sup> of people worldwide.

While there are many types of arthritis, the most common type is osteoarthritis, which is associated with the breakdown of cartilage in the joints.

Numerous studies<sup>®</sup> have found that extracts from avocado and soybean oil, called avocado/soybean unsaponifiables (ASU), may reduce the pain and stiffness associated with osteoarthritis.

You can find ASU supplements in most wellness stores and online. But be sure to speak with a healthcare professional to make sure it's right for you.

## Rich in antioxidants

A diet rich in antioxidants helps fight free radicals, which are unstable compounds that can damage cells over time. When an imbalance occurs, this can lead to oxidative stress.

Fortunately, avocado oil contains a large number of antioxidants to benefit your health, such as carotenoids, tocopherols (forms of vitamin E), and various plant sterols.

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## The takeaway

Avocado oil is delicious, nutritious, and easy to use.

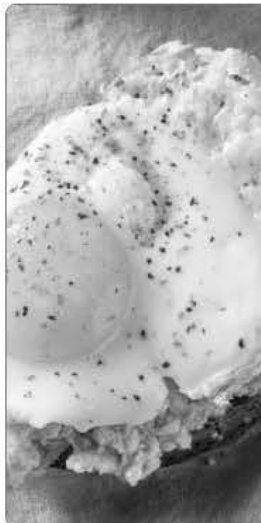
It's rich in oleic acid (a monounsaturated fat), polyunsaturated fats, carotenoids, and other antioxidant-rich nutrients that are linked to improved heart, skin, and eye health.

You can easily add it to your diet in a salad, as part of a dip or marinade, or as a replacement for most other plant oils.

If you're looking to switch things up, give avocado oil a try.

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Last medically reviewed on November 11, 2024

## How we reviewed this article:

SOURCES HISTORY

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Our experts continually monitor the health and wellness space, and we update our articles when new information becomes available.

# EXHIBIT 7



[Home](#) / [Recipes + Tips for Healthy Living](#) / [Avocado Oil as a High Heat Cooking Oil](#)

## AVOCADO OIL AS A HIGH HEAT COOKING OIL

Chosen Team



### LATEST & GREATEST

- [Pepper Jelly and Cream Cheese Tartlets](#)
- [Cheesy Savory Christmas Wreath](#)
- [Snowflake Sugar Cookies](#)
- [Beef Tamales](#)
- [Festive Ham and Cheese Breakfast Bake](#)

Chosen Foods naturally refined, expeller-pressed [avocado oil](#) is the perfect high heat cooking oil. With health benefits similar to olive oil, a smoke point high enough to avoid toxins and trans fats and low in polyunsaturated fat, there isn't another oil available that is better for high heat applications.

## VIRGIN VS REFINED AVOCADO OIL

### REFINED AVOCADO OIL

Chosen Foods naturally refined expeller-pressed avocado oil has a smoke point of 500°F. This smoke point allows you to safely sear, sauté, stir-fry, barbecue and even bake at high temps without your oil breaking down. We consider refined avocado oil a kitchen workhorse.

### VIRGIN AVOCADO OIL

[Virgin avocado oil](#), while beautiful in color and also very healthy, does not have as high of a smoke point. It is common to see all avocado oil listed with a 500 plus degree smoke point, with no differentiation between virgin and refined. We love virgin avocado oil and its many purposes but want to set the record straight. Only a refined avocado oil can reach a 500-degree smoke point. Virgin avocado oil comes in at 350-375 degrees, similar to olive oil. With its bold flavor, virgin avocado oil is great for salad dressings, drizzling's, marinades, and gentle cooking. We consider it more of a finishing oil.

## THE CONSEQUENCES OF THE WRONG OIL FOR HIGH HEAT COOKING

Another important thing to consider with choosing a high heat cooking oil is its polyunsaturated fat content. Oils that are high in polyunsaturated fats should never be heated, regardless of their smoke point. This is due to them being highly reactive & unstable when being affected by heat. The longer the oil is heated, the more negative effects it could have.

Typical polyunsaturated oils include corn, soy, sunflower, grapeseed, safflower, and rice bran. Refined versions of these oils are all advertised as high heat cooking oils. Avoid them, they should have no place in any healthy kitchen. Especially try to avoid them at restaurants and fast-food chains where the likelihood of the oil being incredibly rancid is much higher. For more healthier food that contain polyunsaturated fats, try incorporating wild fish & chia seeds into your diet.

## RECOMMENDED HIGH HEAT COOKING OILS

Instead, choose oils high in monounsaturated and saturated fats. They are much more stable and suitable for high heat cooking. These include avocado, olive, coconut, peanut, high oleic sun/safflower and canola oil.

## HOW OIL IS PROCESSED

The last thing to consider when choosing a high heat cooking oil is how the oil was processed. Even though canola oil and peanut are high in monounsaturated fat and have a relatively high smoke point, they are often refined in very unhealthy ways.

## RECOMMENDED HIGH TEMPERATURE COOKING OILS

Choose oils that are either cold-pressed and virgin, or expeller-pressed and naturally refined. Chosen Foods avocado oil is naturally refined and expeller pressed.

## HERE ARE THE THREE THINGS YOU SHOULD LOOK FOR IN YOUR OILS:

### 1. DOES IT HAVE A HIGH ENOUGH SMOKE POINT FOR MY COOKING NEEDS?

#### Low Heat Cooking Oils:

- Extra Virgin Olive Oils
- Coconut Oil
- Grapeseed Oil
- Canola Oil

#### High Heat Cooking Oils:

- Canola Oil
- High Oleic Safflower Oil
- Avocado Oils

### 2. IS IT MONO OR SATURATED FAT AND HAVE LOW POLYUNSATURATED FAT LEVELS?

Check the labels on the back of your cooking oil to really understand how it's made.

### 3. WAS IT EITHER COLD-PRESSED OR EXPELLER-PRESSED AND NATURALLY REFINED?

Familiarize yourself with the brand & their website to really understand their processes.

If you intend to sear, stir-fry, barbecue, broil, deep-fry, bake or roast at a temperature higher than 400 degrees, Chosen Foods naturally refined avocado oil is the absolute best option available. With a 500-degree smoke point, stable monounsaturated fats, make it your go-to, high-heat, naturally refined cooking oil.

Interested in trying for yourself? Shop [Chosen Foods High Heat Avocado Oil](#).



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# EXHIBIT 8

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# Canola Oil vs. Vegetable Oil: What's Healthiest?



Medically reviewed by  
**Katherine Marengo LDN,  
R.D., Nutrition** — Written by  
Sagan Morrow — **Updated**  
on September 21, 2023

[Canola oil](#) | [Vegetable oil](#) | [Safe storage](#) | [Other oils](#) | [Takeaway](#)

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Canola and vegetable oil may seem interchangeable, but they actually have different qualities when it comes to nutrition and best use.

Most of us use some type of oil every day while cooking. Do you know which types of oil are the healthiest for you and which ones are the best to use in different types of cooking?

## Canola oil



d3sign/Getty Images

When looking at different types of oil, keep three things in mind:

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1. its smoking point (the temperature at which the oil starts to break down, making it unhealthy)
2. the type of fat that it contains
3. its flavor

[Canola oil](#) can be heated to a variety of temperatures, and it has a neutral taste.

This makes it a favorite cooking oil for many. Canola oil is widely considered to be a healthy oil as it's low in saturated fat and high in monounsaturated fat.

Both monounsaturated and polyunsaturated fats can improve cholesterol levels and lower your risk of heart disease. Saturated fat, which is more prevalent in animal products and also found in coconut and palm oil, raises blood cholesterol levels.

It's better to limit the amount of saturated fat in your diet.


Canola plants are a variety of the rapeseed plant that have been crossbred to remove most of a toxic substance called erucic acid from their seeds. The seeds are harvested, then pressed and treated with hexane to draw out as much oil as possible.

Most canola<sup>🔗</sup> planted in the US is genetically modified for herbicide resistance. There is also some controversy about whether GMOs are safe in the long term. Long-term safety studies aren't yet available, and there is still debate over whether GMOs are healthy or unhealthy.

Nevertheless, the FDA, EPA, and USDA have all ensured<sup>🔗</sup> that GMOs are safe for human, plant and animal health.

The important thing is to be aware of whether your foods contain GMO ingredients or not. Make your choice with that knowledge!

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## Vegetable oil

Vegetable oil is often a mix or a blend of different types of oils. It's a more generic type of oil that many people use in their everyday cooking. Vegetable oil is often an inexpensive choice that can be used for all kinds of cooking. And like canola oil, it has a neutral flavor.

The problem with this type of generic oil is that you're less likely to know exactly what's in your oil. This includes how the plants from which the oil was extracted were grown and how the oil was processed.

Also, the vegetable oil sold in grocery stores in the US is mainly soybean or corn oil or a combination of the two, which are both almost always<sup>🔗</sup> genetically modified. So in fact, both foods are almost equally likely to be GMO products.

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The ratio of saturated fat, polyunsaturated fat, and monounsaturated fat varies depending on what oils have been included in the blend (sunflower, corn, soy, safflower, etc.), so you won't have as much control over the types of fats you're eating.

## Safe storage of cooking oil

Unfortunately, cooking oils can be prone to going rancid, particularly when exposed to oxygen. When oxygen interacts with the compounds in oils, it results in the breakdown of peroxides. This can give cooking oils an unpleasant smell or taste.

With time, the oxygen can contribute to a greater number of [free radicals](#). These are potentially harmful compounds that have been linked to cell damage and potentially to causing cancer. As a result, it's important that you take care where you store your cooking oils and how long you store them.

Most cooking oils should be kept in a cool, dry place. In particular, keep them away from heat (above or too close to the stove) and sunlight (in front of a window).

Wrap clear glass bottles of oil in aluminum foil or another material to keep light out and to extend the life of the oil.

If you purchase a large bottle of oil, you may wish to transfer some oil to a small bottle that you'll use more quickly. The rest can be stored in the refrigerator or in a cool place away from sunlight.

If you purchase cooking oils that contain herbs and vegetables (such as chili peppers, [garlic](#), tomatoes, or mushrooms), they can be prone to bacterial growth, including *Clostridium botulinum* bacteria (which can cause [botulism](#)).

Oils with this kind of mixture should be refrigerated after opening and used within four days after opening for maximum freshness and taste.

Generally, most cooking oils go bad in about three months. That's more incentive to go ahead and cook healthy foods with them.

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## Other healthy oils

## Avocado oil

Avocado oil has a high smoke point. This means that it's ideal for searing, browning, or baking foods. Avocado oils are high in monounsaturated fats, with polyunsaturated fats about half those of monounsaturated.

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The oil can be costly because it takes many avocados to create even a small amount of oil. However, it has an excellent, neutral flavor that makes it ideal for adding to soups, drizzling over fish or chicken before baking, or mixing with vegetables for roasting.

## Extra virgin olive oil

Full of good-for-you monounsaturated fat, olive oil is best used at medium- or low-heat cooking temperatures.

When you choose good-quality extra-virgin olive oil, the flavor is excellent, making it a great choice for salad dressings.

## Coconut oil

While coconut oil may be high in saturated fats, it also has a beneficial effect on a person's high-density lipoprotein (HDL) levels. HDL is also known as a person's "good" cholesterol, which works to reduce levels of unwanted high cholesterol.

However, because coconut oil is so high in saturated fats, most health experts recommend using it sparingly. Coconut oil has a medium smoke point, making it best for using with low-heat baking and sautéing.

## Grapeseed oil

Grapeseed oil has a smoke point that's medium high, meaning that you can use it safely for a variety of different types of cooking.

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This type of oil is high in omega-6 fatty acids, a type of polyunsaturated fat that needs to be balanced with omega-3s, another type of polyunsaturated fat.

It's a good idea to increase your intake of other foods that include a higher ratio of omega-3 to omega-6 fats in your diet to compensate.

## MCT oil

Medium chain triglycerides (MCT) oil is a cooking oil known to be low in calories and is an excellent source of energy for the body. As a result, some athletes use MCT oil to enhance athletic performance.

However, if a person simply chooses to consume MCT oil by the tablespoon, they should start in small doses. Eating too much at a time is associated with nausea.

Was this article helpful?

Yes

No



Also, don't heat the oil higher than 150 to 160 degrees and it's best to use the taste. Many people enjoy MCT oil as a salad dressing (and, no doubt, are happy to avoid keeping track of the oil's temperature on the stove).

## Peanut oil

**Peanut oil** is a flavorful oil high in **resveratrol**, a compound that helps to fight heart disease and reduces a person's cancer risk. This oil is well-balanced in terms of monounsaturated and polyunsaturated fats.

It has a medium-high smoke point, which makes it ideal for stir-frying, baking, or cooking dishes in the oven.

## Sesame oil

With a more balanced ratio of monounsaturated and polyunsaturated fats, sesame oil is best used when heated only very lightly or not at all. You can also use it in salads and no-cook dishes to preserve the nutrients.

## Takeaway

You can get other kinds of gourmet oils too, like macadamia nut oil! Don't be afraid to get creative.

As you can see, when trying to choose a healthy oil, one of the best things you can do is to enjoy a variety of oils that are higher in monounsaturated and polyunsaturated fats and lower in saturated fats.

The more variety you have in your diet with the types of fats you consume, the more nutrients you get.



*Sagan Morrow is a freelance writer and editor as well as a professional lifestyle blogger at [SaganMorrow.com](https://SaganMorrow.com). She has a background as a certified holistic nutritionist.*

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### ● Current Version

#### ○ Sep 21, 2023

Written By

Sagan Morrow

Edited By

John Bassham

Medically Reviewed By

Katherine Marengo, LDN, RD

Copy Edited By

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#### ○ Sep 30, 2018

Written By

Sagan Morrow

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# Olive Oil vs. Canola Oil: Which Is Healthier?

[What are they](#) | [Nutrition](#) | [Uses](#) | [Recommendation](#) | [Bottom line](#)

Canola oil and olive oil are two of the most popular cooking oils worldwide.

They are both promoted as heart-healthy and share similar uses. However, some people wonder how they're different and which is healthier.

This article explains the differences between canola and olive oil.

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Michelle Arnold/EyeEm/Getty Images

## What are canola oil and olive oil?

Canola oil is made from rapeseed (*Brassica napus* L.) that has been bred to be low in toxic compounds like erucic acid and glucosinolates, which rapeseed naturally contains. This engineering makes [canola oil](#) safe for consumption (1).

Canola processing generally involves heating, pressing, chemical extraction, and refining, but expeller and cold-pressed canola oil is also available. The oil also undergoes bleaching and deodorizing, which give it a neutral color and odor (2).

On the other hand, olive oil is made from pressed olives, the fruits of the olive tree.

While many types exist, the two most popular are regular or "pure" olive oil and extra virgin olive oil.

Extra virgin olive oil is extracted using only pressing, while regular olive oil contains a combination of virgin (pressed) oil and refined (heated or chemically

Although [extra virgin olive oil](#) is more expensive than regular olive oil, it is considered healthier because it's less refined.

## SUMMARY

Canola oil is made from selectively bred rapeseeds. Meanwhile, olive oil is made from pressed olives and come in several forms.

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## Similar nutritional profile

In terms of nutrients, canola and [olive oil](#) are quite similar.

The nutrients in 1 tablespoon (15 ml) of canola and regular (refined) olive oil are (5, 6):

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	Canola	Olive
Calories	124	124
Fat	14 grams	14 grams
• Saturated	7%	14%
• Monounsaturated	64%	73%
• Polyunsaturated	28%	11%
Vitamin E	16% of the RDI	13% of the RDI
Vitamin K	8% of the RDI	7% of the RDI

Notably, olive oil provides more saturated and [monounsaturated](#) fat, whereas canola oil contains more polyunsaturated fat.

## Antioxidant content

Canola and olive oil differ significantly in their content of [antioxidants](#), compounds that neutralize potentially harmful molecules called free radicals.



Free radicals are highly unstable and can cause cellular damage when levels get too high in your body. Studies link free radical damage to chronic illnesses, such as heart disease, diabetes, Alzheimer's, and certain cancers (7<sup>6</sup>).

Olive oil boasts over 200 plant compounds, including polyphenols, which act as powerful antioxidants in your body (8<sup>6</sup>).

However, the amount of polyphenols depends on the processing method (9<sup>6</sup>).

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Because the refining process significantly reduces antioxidant content, regular olive oil has a low polyphenol count. Meanwhile, extra virgin olive oil is packed with polyphenols (1<sup>6</sup>, 2<sup>6</sup>, 9<sup>6</sup>).

These include oleuropein, hydroxytyrosol, and oleocanthal, which are linked to a lower risk of heart disease and reduced inflammation (10<sup>6</sup>).

#### SUMMARY

Olive oil and canola oil have similar amounts of fat and calories but a different fatty acid composition. Olive oil — especially extra virgin — is also higher in antioxidants than canola oil.

## Culinary uses

# EXHIBIT 9



# EXHIBIT 10





# EXHIBIT 11



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- ◆ ATTENTION OF Rick Lyon
- ◆ REPORT DATE 1-7-25
- ◆ CEUTICAL LABS PROJECT # 59028
- ◆ ANALYST NAME R. Robles / I. Wang / D. Treybig
- ◆ ANALYSIS REQUESTED Appearance, FTIR, Peroxide Value, Acidity, Fatty Acid Profile (13 FFAs from C14 to C24), Tocopherols ( $\alpha$ ,  $\beta$ ,  $\gamma$ ,  $\delta$ ), Sterols Profile, Chlorophylls, [K232, K270,  $\Delta K$ ]
- ◆ METHODS USP-NF2024, Food Control 143 (2023) 109277
- ◆ SAMPLE TYPE Finished Product

◆ SAMPLE IDENTIFICATION AND RESULTS

*Final Results*

SAMPLE IDENTIFICATION	CL LAB ID
Avocado Oil (Walmart), Lot # L-A4276N-292-7	CU807

TEST	REQUIREMENT	RESULT
Appearance	A Yellow to Slight Green Color	Conforms
FTIR	Conforms to Standard	Conforms
Peroxide Value	Report Result	3.65 mEq/g
Acidity	Report Result	0.08 %
C14:0	Not Detected-0.3 %	9.62 %
C16:0	11.0-26.0 %	12.34 %
C16:1	4.0-17.1 %	Below Detectable Limits
C17:0	Not Detected-0.3 %	Below Detectable Limits
C17:1	Not Detected-0.1 %	Below Detectable Limits

The results stated above are provided with the most accurate method available. However, the test method has not been validated to current USP and ICH guidelines for this product. Method validations are the responsibility of the manufacturer for each product



C18:0	0.1-1.3 %	Below Detectable Limits
C18:1	42.0-75.0 %	Below Detectable Limits
C18:2	7.8-19.0 %	13.87 %
C18:3	0.5-2.1 %	0.68 %
C20:0	Not Detected-0.7 %	Below Detectable Limits
C20:1	Not Detected-0.3 %	14.41 %
C22:0	Not Detected-0.5 %	14.59 %
C22:1	Not Detected	5.35 %
C22:2	Not Detected	14.79 %
C22:3	Not Detected	14.35 %
C24:0	Not Detected-0.2 %	Below Detectable Limits
$\alpha$ -Tocopherol	70-190 mg/ kg	120.93 mg/ kg
$\delta$ - Tocopherol	70-190 mg/ kg	15.62 mg/ kg
$\gamma$ + $\beta$ - Tocopherol	70-190 mg/ kg	40.63 mg/ kg
Total Tocopherols	70-190 mg/ kg	177.2 g/ kg
Campesterol	Report Result	7.88 %
Stigmasterol	Report Result	0.39 %
$\beta$ -Sitosterol	Report Result	91.73 %
Total Sterols Profile	Report Result	100.00 %
Chlorophylls	Report Result	0.243 ppm
K232	1.4-3.5	1.8
K270	0.4-1.6	0.9
$\Delta$ K	Report Result	0.1075

Technical Review

Date

Quality Review

Date

The results stated above are provided with the most accurate method available. However, the test method has not been validated to current USP and ICH guidelines for this product. Method validations are the responsibility of the manufacturer for each product

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2  
3 CENTRAL DISTRICT OF CALIFORNIA  
4  
5 WESTERN DIVISION

5 EDIE GOLIKOV, individually and on  
6 behalf of all others similarly situated,

7 Plaintiff,

8 vs.

9 WALMART INC.,

10 Defendant.

Case No. 24-cv-08211-RGK-MAR

11 **DECLARATION OF IMEL**  
12 **COURTLAND IN SUPPORT OF**  
13 **PLAINTIFF'S OPPOSITION TO**  
14 **DEFENDANT'S MOTION TO**  
15 **DISMISS**

16 Compl. filed: September 24, 2024

17 Assigned to the Hon. R. Gary Klausner  
18 Dept.: Courtroom 850  
19  
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28



**DECLARATION OF IMEL COURTLAND**

I, Imel Courtland, declare and state as follows:

1. I am an employee of Ceutical Labs, a laboratory that was retained by the law firm Dovel & Luner, LLP to test the purity and composition of a sample of Walmart's Great Value Avocado Oil (Lot # L-A4276N-292-7).

2. To test the composition and purity of the Great Value Avocado Oil sample, Ceutical Labs applied the methodology outlined by Hilary S. Green and Selina C. Wang in the scientific journal Food Control, Volume 143. *See* Hilary S. Green, Selina C. Wang, *Evaluation of proposed CODEX purity standards for avocado oil*, 143 FOOD CONTROL 109277 (Jan. 2023), accessible at <https://www.sciencedirect.com/science/article/pii/S0956713522004704#sec2>. The methodology involves testing the sample's fatty acid profile, sterols profile, and tocopherol.

3. The fatty acid profile test measures the proportions of various fatty acids present in the tested oil. Unadulterated avocado oil has a specific range of fatty acids that reflect its natural composition. Adulterated avocado oil exhibits fatty acid levels outside this expected range.

4. The tested sample of Great Value Avocado Oil is adulterated with an oil other than avocado oil. Specifically, avocado oil does not contain any "C20" or "C22" fatty acids. The tested sample, however, contained C20, C20:1, C22:0, C22:1, C22:2, and C22:3 fatty acids. These results indicate that the tested oil is adulterated with some other oil that is not avocado oil.

5. Additionally, unadulterated avocado oil exhibits a certain range of tocopherol (70-190 mg/kg).

6. The tested sample contained tocopherols outside of these ranges, which further indicates that the sample was adulterated with a different type of oil. Specifically, the sample contained 15.62 mg/kg of  $\delta$ -tocopherols, 40.63 mg/kg of  $\gamma$ - +  $\beta$  tocopherols. These results are outside the range of tocopherols present in

1 unadulterated avocado oil, indicating that the sample was adulterated with other  
2 avocado oils.

3 7. In sum, the testing that my laboratory conducted on the sample of  
4 Great Value Avocado Oil reveals that the sample is adulterated with oils other than  
5 avocado oil.

6 I declare under penalty of perjury that the foregoing is true and correct.

7 Executed this 16th day of January, 2025, at Los Angeles, California.

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9 Imel Courtland:  \_\_\_\_\_

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# **EXHIBIT E**

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Walmart Inc.*

**UNITED STATES DISTRICT COURT  
CENTRAL DISTRICT OF CALIFORNIA  
WESTERN DIVISION**

EDIE GOLIKOV, individually and on  
behalf of all others similarly situated,

Plaintiff,

vs.

WALMART INC.,

Defendant.

Case No. 2:24-cv-08211-RGK-MAR

**DECLARATION OF WALMART'S  
AVOCADO OIL SUPPLIER IN  
SUPPORT OF WALMART'S  
OPPOSITION TO PLAINTIFF'S  
MOTION FOR CLASS  
CERTIFICATION**

[REDACTED VERSION OF  
DOCUMENT PROPOSED TO BE  
FILED UNDER SEAL]

**DECLARATION OF AVOCADO OIL SUPPLIER**

I, [REDACTED], declare and state as follows:

1. My named is [REDACTED]. I am the Director of Raw Materials and Laboratory for [REDACTED] which operates [REDACTED] an international cooking oil manufacturing and bottling company headquartered in Monterrey, Mexico. I make this declaration in support of Walmart's Opposition to Plaintiff Edie Golikov's Motion for Class Certification. I have personal knowledge of the facts set forth in this declaration, and if called as a witness, I could and would competently testify to them.

2. [REDACTED] produces and bottles "private label" or "white label" avocado oil that is sold by third-parties under their own label. This includes Walmart, Inc.'s "Great Value" brand avocado oil. [REDACTED] has been and is the exclusive supplier of Walmart Great Value avocado oil for the period of sales I understand is at issue in this lawsuit, which includes Walmart Great Value avocado oil sold from September 2020 through the present.

3. [REDACTED] products sold as Walmart Great Value avocado oil contain only refined avocado oil, and are not mixed with or adulterated by any product or other oils.

4. [REDACTED] engages in extensive quality control and industry-standard testing to ensure that all of the avocado oil that it bottles and ships to Walmart is only refined avocado oil and of sufficiently high quality to sell to consumers. This quality control includes both supplier vetting and multiple rounds of testing of each batch of raw avocado oil. Also the company sends randomly selected products to external certified laboratories to guarantee the authenticity of the product. [REDACTED] does not ship any Great Value avocado oil that does not pass its quality control testing.

5. Before [REDACTED] begins working with any source of avocado oil raw materials, it tests multiple avocado oil samples from that source and analyzes their



1 quality and purity, according to the technical specifications provided and approved  
2 by the client. The source is approved only if these test show that their product  
3 consists entirely of refined avocado oil and passes quality standards.

4 6. Then, once each supplier is vetted and approved, [REDACTED] continues to  
5 test every batch of their oil. Every batch of refined avocado oil that is received  
6 from suppliers at [REDACTED] factory is tested upon receipt for quality and to ensure  
7 that it is refined avocado oil, and only refined avocado oil. If it does not pass the  
8 test, then the batch is rejected and is not processed, not bottled, and not passed on to  
9 consumers.

10 7. Once a batch of refined avocado oil is received from the supplier and  
11 passes the first round of purity and quality testing, it is bottled for retail consumers  
12 at [REDACTED] factories. Every batch of [REDACTED] refined avocado oil, including every  
13 batch of Walmart Great value refined avocado oil, is then tested for quality and  
14 purity a second time after it has been bottled. For this second test of the finished  
15 product, [REDACTED] employees randomly select bottles from each batch for testing,  
16 open the bottles, and test the product. Because the tests are conducted on sealed  
17 bottles from each batch, these samples are representative of each batch of refined  
18 avocado oil that is shipped to Walmart. Any batches that do not pass this second  
19 test are rejected and are not shipped to [REDACTED] Walmart.

20 8. [REDACTED] has used this same testing protocol in each batch it has  
21 bottled.

22 9. [REDACTED] also takes extensive precautions to ensure that there is no  
23 cross-contamination between refined avocado oil batches. This ensures that tests of  
24 each batch are representative and can be traced to the supplier, and also ensures that  
25 refined avocado oil that does not meet specifications is not passed on to consumers.

26 10. I have reviewed the results of the document described by the plaintiff's  
27 counsel, Richard Lyon (and attached to his declaration as Exhibit 11), as the  
28 January 7, 2025 Ceutical Labs test results conducted at the request of Dovel &

1 Luner LLP and submitted in support of Plaintiff Edie Golikov's motion for class  
2 certification. The results state that the tested sample was from taken Walmart  
3 refined Avocado Oil, Lot # L-14276N-292-7. I have shared this document provided  
4 as Exhibit 11 to the Lyon declaration with other scientists and staff at  
5 [REDACTED]. We see several problems. First, it doesn't match our records.  
6 [REDACTED] conducted its own testing of Walmart refined Avocado Oil, Lot # L-  
7 14276N-292-7, the same batch reflected in the Ceutical Labs report. I consulted  
8 [REDACTED]'s records and was able to locate and review the testing result for that Lot #  
9 L-14276N-292-7. Spraylab's test results state that the refined avocado oil in L-  
10 14276N-292-7 was refined avocado oil and only refined avocado oil, not mixed  
11 with or adulterated by any other oil. Second, the report included as Exhibit 11 has  
12 anomalies that look inconsistent with known and industry standards. For example,  
13 we are not aware of any vegetable edible oils that do not have the parameter C18:1  
14 (oleic acid), does not follow known standards. Third, the report in Exhibit 11 is  
15 missing key metrics in the report, including: Traceability registry of laboratory  
16 (sample reception date, analysis start/end date).

17 11. [REDACTED] conducted its own testing of Walmart refined Avocado Oil,  
18 Lot # L-14276N-292-7, the same batch reflected in the Ceutical Labs report. I  
19 consulted [REDACTED] records and was able to locate and review the testing result for  
20 that Lot # L-14276N-292-7. [REDACTED] test results state that the refined avocado oil  
21 in L-14276N-292-7 was refined avocado oil and only refined avocado oil, not  
22 mixed with or adulterated by any other oil.

23 12. I understand that Walmart has requested that my name and company  
24 name be sealed because the information sufficient to identify the supplier and  
25 details of the supplier's quality control processes are confidential business  
26 information that would be harmful to Walmart's competitive advantage against  
27 competing businesses. I agree, and it also would harm our competitive advantages  
28 with other suppliers. In the ordinary course, [REDACTED] and Walmart keeps its

1 information and relationship confidential and only shares such information on a  
2 need-to-know basis. If this information were public, our and Walmart's  
3 competitors may use such information to gain an unfair competitive advantage by  
4 using the information to develop similar products or pursue competing contracts  
5 with suppliers. Walmart's and our competitors could also use supplier identities to  
6 market or price their own products, adapt quality control processes of their own  
7 suppliers, and derive additional business sensitive information such as profit margin  
8 and costs. Moreover, Walmart's supplier selection is based on a variety of  
9 proprietary factors including cost, demand, geography, and time, all of which  
10 Walmart and [REDACTED] invest substantial resources to develop in a  
11 competitive and efficient manner. Disclosure of this information would thus lead to  
12 financial and competitive harm. As such, Walmart and [REDACTED] make great  
13 efforts to protect the confidentiality of their supplier relationship.

14 I declare under penalty of perjury of the laws of the United States that the  
15 foregoing is true and correct.

16 Executed this 17th day of January, 2025, at Grenada, Spain.

17 [REDACTED]  
18 [REDACTED]

19 [REDACTED]  
20 [REDACTED]  
21 [REDACTED]  
22 [REDACTED]  
23 [REDACTED]  
24 [REDACTED]  
25 [REDACTED]  
26 [REDACTED]  
27 [REDACTED]  
28 [REDACTED]

# **EXHIBIT F**

UNITED STATES DISTRICT COURT  
CENTRAL DISTRICT OF CALIFORNIA

**CIVIL MINUTES - GENERAL**

Case No. 2:24-cv-08211-RGK-MAR

Date February 27, 2025

Title *Eddie Golikov v. Walmart Inc.*

Present: The Honorable R. GARY KLAUSNER, UNITED STATES DISTRICT JUDGE

Joseph Remigio

Not Reported

N/A

Deputy Clerk

Court Reporter / Recorder

Tape No.

Attorneys Present for Plaintiff:

Attorneys Present for Defendant:

Not Present

Not Present

**Proceedings: (IN CHAMBERS) Order Re: Motion to Dismiss Case [DE 37]**

**I. INTRODUCTION**

On December 30, 2024, Eddie Golikov (“Plaintiff”) filed a First Amended Class Action Complaint (“FAC”) against Walmart Inc. (“Defendant”) alleging: (1) violation of California’s False Advertising Law (“FAL”); (2) violation of California’s Consumer Legal Remedies Act (“CLRA”); (3) violation of California’s Unfair Competition Law (“UCL”); (4) breach of express warranty; (5) negligent misrepresentation; (6) intentional misrepresentation; and (7) quasi contract. (ECF No. 31.) Plaintiff seeks injunctive relief, restitution, damages, and punitive damages.

Presently before the Court is Defendant’s Motion to Dismiss. (ECF No. 37.) For the following reasons, the Court **GRANTS** Defendant’s Motion **in part**.

**II. FACTUAL BACKGROUND**

Plaintiff alleges the following:

Avocado oil has become a popular culinary product due to its mild flavor, nutritional benefits, and ease of use in cooking. Consumers are often willing to pay a premium for avocado oil, particularly if it has not been adulterated with other, less desirable cooking oils. However, avocado oil is significantly more expensive to produce. As a result, manufacturers and retailers have an incentive to increase their profits by selling adulterated avocado oil that has been blended with poor quality or cheaper oils to unknowing customers. Indeed, since at least 2020, the industry has been aware of issues with adulteration.

Defendant is a retail chain that markets, distributes, and sells Great Value Avocado Oil (the “Product”). The front-label states, “Refined Avocado Oil” and includes graphics of avocados. The back-label lists “Avocado Oil” as the sole ingredient contained.



UNITED STATES DISTRICT COURT  
CENTRAL DISTRICT OF CALIFORNIA

CIVIL MINUTES - GENERAL

Case No. 2:24-cv-08211-RGK-MAR

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Title *Eddie Golikov v. Walmart Inc.*



Plaintiff, a resident of Tarzana, California, purchased the Product on November 14, 2021. Plaintiff read and relied on the labels before making the purchase believing that the Product contained unadulterated avocado oil without any other ingredients. Plaintiff would not have purchased the Product or would have paid less for it if she knew or believed that other ingredients were present.

But in October of 2023, almost two years after Plaintiff purchased and used the Product, researchers at the University of California, Davis (“UC Davis”) published a scientific study concluding that the Product was likely adulterated. The researchers analyzed a few bottles of the Product produced around 2020 or 2021 and found that their fatty acid and sterol profiles were consistent with high levels of other cheaper oils. Though the researchers acknowledged that there were possible alternative explanations for these results, they ultimately concluded that the Product was likely adulterated, and thus, its labeling was inaccurate.

Defendant knew, or reasonably should known that the Product was adulterated. Given the widespread awareness of adulteration in the industry, Defendant tested, or reasonably should have tested the Product for adulteration. In so doing, it learned, or reasonably should have learned that the Product was adulterated, yet failed to address the problem.

UNITED STATES DISTRICT COURT  
CENTRAL DISTRICT OF CALIFORNIA

CIVIL MINUTES - GENERAL

Case No. 2:24-cv-08211-RGK-MAR

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**III. JUDICIAL STANDARD**

Under Federal Rule of Civil Procedure (“Rule”) 8(a), a complaint must contain a “short and plain statement of the claim showing that the [plaintiff] is entitled to relief.” *Bell Atl. Corp. v. Twombly*, 550 U.S. 544, 555 (2007). If a complaint fails to adequately state a claim for relief, the defendant may move to dismiss the claim under Rule 12(b)(6) to dismiss for failure to state a claim upon which relief can be granted. Fed. R. Civ. P. 12(b)(6). “To survive a motion to dismiss, a complaint must contain sufficient factual matter, accepted as true, to ‘state a claim to relief that is plausible on its face.’” *Ashcroft v. Iqbal*, 556 U.S. 662, 678 (2009) (quoting *Twombly*, 550 U.S. at 570). A claim is facially plausible if the plaintiff alleges enough facts to allow the court to draw a reasonable inference that the defendant is liable. *Id.* A plaintiff need not provide detailed factual allegations, but must provide more than mere legal conclusions. *Twombly*, 550 U.S. at 555. However, “[t]hreadbare recitals of the elements of a cause of action, supported by mere conclusory statements do not suffice.” *Iqbal*, 556 U.S. at 678.

When ruling on a 12(b)(6) motion, the court must accept the allegations in the complaint as true and construe them in the light most favorable to the non-moving party. *Cahill v. Liberty Mut. Ins. Co.*, 80 F.3d 336, 337–38 (9th Cir. 1996). “Factual allegations must be enough to raise a right to relief above the speculative level.” *Twombly*, 550 U.S. at 555. Dismissal is “appropriate only where the complaint lacks a cognizable legal theory or sufficient facts to support a cognizable legal theory.” *Mendiondo v. Centinela Hosp. Med. Ctr.*, 521 F.3d 1097, 1104 (9th Cir. 2008).

Additionally, a plaintiff alleging a claim sounding in fraud must meet the more exacting pleading requirements of Rule 9(b), which require a party to “state with particularity the circumstances constituting fraud or mistake.” Fed. R. Civ. P. 9(b). To satisfy this standard, a “complaint must identify the who, what, when, where, and how of the misconduct charged, as well as what is false or misleading about the purportedly fraudulent statement, and why it is false.” *Salameh v. Tarsadia Hotel*, 726 F.3d 1124, 1133 (9th Cir. 2013) (citing *Cafasso, United States ex rel. v. Gen. Dynamics C4 Sys., Inc.*, 637 F.3d 1047, 1055 (9th Cir. 2011)).

**IV. DISCUSSION**

Plaintiff alleges that Defendant misrepresented that the Product contained unadulterated avocado oil when it was in fact adulterated with other, cheaper oils. Plaintiff thereby asserts seven claims: (1) violation of FAL; (2) violation of CLRA; (3) violation of UCL; (4) breach of express warranty; (5) negligent misrepresentation; (6) intentional misrepresentation; and (7) quasi contract.

Defendant moves to dismiss. Specifically, Defendant argues that the FAC should be dismissed in its entirety because Plaintiff fails to adequately allege falsity or materiality as required for each claim. Defendant further argues that, to the extent that the FAC should not be dismissed in its entirety, the

UNITED STATES DISTRICT COURT  
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Court should dismiss Plaintiff's intentional misrepresentation claim and request for punitive damages for other, claim-specific deficiencies. The Court first considers falsity and materiality.

A. Falsity

At the heart of a claim for violation of California consumer protection statutes, as well any related tort claim, is a misrepresentation or false statement. *See Ham v. Hain Celestial Grp., Inc.*, 70 F. Supp. 3d 1188, 1193 (N.D. Cal. 2014).

Here, Plaintiff alleges that the Product label falsely stated that it contained only avocado oil when it was actually adulterated with other, cheaper oils, as confirmed by a UC Davis study. Defendant argues that Plaintiff fails to adequately allege that the Product label was actually false. Specifically, Defendant argues that: (1) Plaintiff's allegations are identical to allegations that were deemed insufficient in *McConnon v. Kroger Co.*, 2024 WL 3941340 (C.D. Cal. June 21, 2024); (2) Plaintiff's reliance on the UC Davis study is improper; and (3) Plaintiff has not provided sufficient details about the alleged adulteration. The Court addresses each argument in turn.

1. *McConnon v. Kroger Co.*

Defendant argues that *McConnon*, in which a district court dismissed similar consumer protection claims against a retailer for mislabeled avocado oil, "compels dismissal" in this case. (Mot. at 7.) Defendant's reliance on *McConnon* is misplaced.

For starters, *McConnon* is not binding authority, and therefore cannot "compel" this Court to do anything. But even putting that faux pas aside, *McConnon* is readily distinguishable and inapplicable to this case. The only relevant similarity between these cases is that both involve claims based on the alleged mislabeling of an avocado oil product. Beyond that, the allegations are significantly different. In *McConnon*, the plaintiff alleged that the product falsely implied that the avocado oil was "pure." *Id.* at \*1. The district court found that these allegations were deficient for two reasons. First, the term "pure" was "nowhere to be found on the bottle." *Id.* at \*3. And second, even if the term "pure" had been on the bottle, it appeared to be susceptible to multiple, widely varying definitions. *Id.* Without a set definition, "neither Defendant nor the Court [could] evaluate the merits of the claim[.]" *Id.*

Here, these deficiencies are not present. First, Plaintiff does not rely on any implied terms. Plaintiff challenges exactly what the label says: that the Product contains only one ingredient—avocado oil. Second, there is no credible dispute or ambiguity as to the meaning of the allegation. Plaintiff claims that, despite the label listing only one ingredient, there are other cheaper oils mixed in with the avocado



UNITED STATES DISTRICT COURT  
CENTRAL DISTRICT OF CALIFORNIA

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oil. Both Defendant and the Court can easily evaluate the merits of such a claim. Thus, this argument fails.<sup>1</sup>

2. *The UC Davis Study*

As noted above, the FAC heavily relies on a UC Davis study which found that a few bottles of the Product were likely adulterated. Defendant argues that Plaintiff's reliance on this study is improper and insufficient to establish falsity because: (1) the study is insufficient to plausibly establish that the exact bottle Plaintiff purchased in 2021 was adulterated; and (2) the study suggests alternative explanations for the results other than adulteration that render adulteration implausible. Both arguments fail.

Defendant first argues that Plaintiff must plausibly allege that the exact bottle of the Product she purchased was adulterated, and that her reliance on the UC Davis study which tested other bottles is insufficient. There are two problems with this argument. First, Defendant does not cite any authority suggesting that Plaintiff must test the particular bottle she purchased. Second, courts routinely allow plaintiffs in consumer protection cases to draw reasonable inferences that the particular item they purchased was defective or mislabeled based on tests of other samples. *See, e.g., Naimi v. Starbucks Corp.*, 798 F. App'x 67, 69 (9th Cir. 2019) (finding laboratory testing of samples sufficient to plausibly allege that each item of a product line was misrepresented); *In re Herbal Supplements Mktg. & Sales Practices Litig.*, 2017 WL 2215025, at \*12 (N.D. Ill. 2017) (collecting cases).

Defendant alternatively argues the study does not plausibly show adulteration because the study acknowledges possible alternative explanations for its results. But the mere existence of alternative explanations is immaterial unless the explanations are "so likely to be true" as to render the plaintiff's theory implausible. *Starr v. Baca*, 652 F.3d 1202, 1216 (9th Cir. 2011); *see also Naimi*, 798 F. App'x at 69 (declining to dismiss claims based on alternative explanations); *Meyer v. Colavita USA Inc.*, 2011 WL 13216980, at \*5 (S.D. Fla. Sept. 13, 2011) (dismissing claim based on a study that yielded "somewhat inconclusive" results). Defendant does not explain why these alternative explanations are more likely than the study's conclusion that the Product was adulterated, let alone so likely as to render adulteration implausible. Thus, these arguments fail.

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<sup>1</sup> The Court notes that Defendant submitted via a Notice of Supplemental Authorities an order from the Eastern District of California, *Hawkins v. Walmart*. (Notice of Supplemental Authorities, ECF No. 61.) Defendant argues that this case also warrants dismissal, as that court dismissed a class action against Defendant over the same Product at issue here. But this case is similarly distinguishable. Much like in *McConnon*, the plaintiff in that case similarly relied on an implied representation of "purity," which the plaintiff neglected to define. Indeed, *Hawkins* relied on *McConnon* to conclude that the allegations were insufficient due to these defects. Again, these defects are not present here. Thus, *Hawkins* is of no moment.

UNITED STATES DISTRICT COURT  
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3. Adulteration

Defendant argues that Plaintiff's allegations are not pled with particularity as required by Rule 9(b) or provide adequate notice as required by Rule 8(a). Specifically, Defendant argues that Plaintiff alleged "only the conclusory fact that the [Product] is impure," but not "how and why it is impure," thereby failing to put Defendant on notice of any particular misconduct. (Mot. at 12.) Defendant misses the mark.

Contrary to Defendant's mischaracterizations, Plaintiff does not ambiguously allege that the Product is "impure." Rather, she unambiguously alleges that the Product was adulterated with other oils not disclosed on the label, citing the UC Davis study for support. This allegation is sufficient to state with particularity that the Product was adulterated, and put Defendant on notice of its alleged misconduct. While Defendant insists that Plaintiff should provide further details, such as the exact type of oil the Product was adulterated with, the amount of oil that was added, and how it was added to the Product, Defendant provides no authority suggesting that this level of detail is necessary. Thus, this argument also fails.

Having found that Defendant's arguments regarding falsity fail, the Court next considers Defendant's arguments regarding materiality.

**B. Materiality**

It is not enough that a plaintiff allege that a misrepresentation was made; to state claims under California's consumer protection statutes and related torts, the plaintiff must also allege that the misrepresentation was material, meaning that "a reasonable man would attach importance to its existence or nonexistence in determining his choice of action in the transaction in question." *In re Tobacco II Cases*, 46 Cal. 4th 298, 327 (2009) (internal quotes omitted).

Plaintiff alleges that the mislabeling is material because consumers are willing to pay a higher price for avocado oil not adulterated with other oils, and consumers rely on the representation of the product packaging before making a purchase. Defendant argues that is insufficient, as Plaintiff's "failure to identify what renders the avocado oil 'adulterated' also precludes materiality." (Mot. at 14.) Defendant's argument appears to rest entirely on the flawed falsity argument that Plaintiff has failed to meticulously detail how, and to what extent the Product was adulterated. Because this argument fails, as described above, Defendant's materiality argument also fails.

Having found each of Defendant's arguments for dismissing the FAC in its entirety unconvincing, the Court considers Defendant's remaining claim-specific arguments for dismissal.



UNITED STATES DISTRICT COURT  
CENTRAL DISTRICT OF CALIFORNIA

**CIVIL MINUTES - GENERAL**

Case No. 2:24-cv-08211-RGK-MAR

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**C. Intentional Misrepresentation**

Under California law, the elements of an intentional representation claim are (1) misrepresentation; (2) knowledge of falsity; (3) intent to defraud; (4) justifiable reliance; and (5) resulting damage. *Roper v. Big Heart Pet Brands, Inc.*, 510 F. Supp. 3d 903, 910–11 (E.D. Cal. 2020). In her sixth cause of action, Plaintiff alleges that Defendant intentionally misrepresented that the Product contained only avocado oil. Defendant argues that this claim fails because Plaintiff does not adequately allege that Defendant knowingly made the misrepresentation. The Court disagrees.

Here, Plaintiff meets the requirement by alleging that Defendant was aware, or reasonably should have been aware of industry-wide problems with adulteration of avocado oil, and accordingly conducted, or reasonably should have conducted tests on the Product through which it learned that the Product was adulterated, yet failed to act. Thus, the Court finds Plaintiff's intentional misrepresentation claim sufficiently pled.

**D. Punitive Damages**

Plaintiff requests punitive damages in her prayer for relief. To seek punitive damages, a plaintiff must allege that the defendant has been guilty of oppression, fraud, or malice. Cal. Civ. Code § 3294. A corporate entity cannot commit willful and malicious conduct; therefore, punitive damages can only be sought if the plaintiff alleges that the wrongful conduct was committed, authorized, or ratified by an officer, director, or managing agent of the corporation. *Id.*; *Roper*, 510 F. Supp. 3d at 926.

Defendant argues that Plaintiff does not allege an “officer, director, or managing agent” of Defendant authorized or ratified the alleged misconduct which is requisite for punitive damages against an entity. Plaintiff's prayer for punitive damages merely rests on her consumer protection claims. Though, as discussed above, these allegations are sufficient to state her claims, they are insufficient for punitive damages, as Plaintiff makes no reference to any officer, director, or managing agent whatsoever. Accordingly, the Court **dismisses** Plaintiff's request for punitive damages.

UNITED STATES DISTRICT COURT  
CENTRAL DISTRICT OF CALIFORNIA

CIVIL MINUTES - GENERAL

Case No. 2:24-cv-08211-RGK-MAR

Date February 27, 2025

Title *Eddie Golikov v. Walmart Inc.*

V. CONCLUSION

For the foregoing reasons, the Court **GRANTS** Defendant's Motion to Dismiss **in part**. The Court **DISMISSES** Plaintiff's request for punitive damages.

IT IS SO ORDERED.

Initials of Preparer

\_\_\_\_\_  
JRE/sf  
\_\_\_\_\_

# **EXHIBIT G**

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*Counsel for Defendant  
Walmart Inc.*

**UNITED STATES DISTRICT COURT  
CENTRAL DISTRICT OF CALIFORNIA  
WESTERN DIVISION**

EDIE GOLIKOV, individually and on  
behalf of all others similarly situated,

Plaintiff,

vs.

WALMART INC.,

Defendant.

Case No. 2:24-cv-08211-RGK-MAR

**DEFENDANT WALMART INC.'S  
REQUESTS FOR PRODUCTION,  
SET ONE**

Assigned to the Hon. R. Gary Klausner

Compl. filed: September 24, 2024  
FAC filed: December 30, 2024

Pursuant to Federal Rules of Civil Procedure 26 and 34, Defendant Walmart Inc. (Walmart) requests that Plaintiff Edie Golikov respond and produce documents responsive to the following Requests for Production (Request or Requests) no later than 30 days after service at the law firm of Davis Wright Tremaine LLP, 350 South Grand Avenue, 27<sup>th</sup> Floor, Los Angeles, CA 90071, for the purpose of inspection and/or copying by Walmart or its counsel.

### **DEFINITIONS**

A. “YOU” or “YOUR” as used herein means Edie Golikov, and her representatives, managers, attorneys, and other agents or representatives acting on her behalf.

B. “WALMART” as used herein means Defendant Walmart Inc.

C. “PRODUCT” or “PRODUCTS” as used herein means the Great Value brand “Refined Avocado Oil” product identified in the operative complaint.

D. “VENDOR” as used herein means vendors, suppliers, and providers that manufacture the PRODUCT(S) and sell them to WALMART.

E. “PERSON” or “PERSONS” as used herein means any natural person or any legal entity, including but not limited to any business or governmental entity, organization, or association.

F. “COMMUNICATION” or COMMUNICATIONS” as used herein means the transmittal of information (in the form of facts, ideas, inquiries, or otherwise) whether orally, in writing, or otherwise, and includes without limitation, meetings, personal conferences, telephone conferences, voicemail messages, memoranda, notes, letters, electronic mail, social media posts, and other computer-generated messages, and instant, direct, and text messages.

G. “DOCUMENT” or “DOCUMENTS” as used herein is synonymous in meaning and equal in scope to its usage in Federal Rule of Civil Procedure 34(a)(1)(A), which states “any designated DOCUMENTS or electronically stored information—including writings, drawings, graphs, charts, photographs, sound



1 recordings, images, and other data or data compilations—stored in any medium  
2 from which information can be obtained either directly or, if necessary, after  
3 translation by the responding party into a reasonably usable form” or any designated  
4 tangible things, or entry onto land or other property. The term “DOCUMENT”  
5 refers to any DOCUMENT now or at any time in YOUR possession, custody, or  
6 control. A PERSON is deemed in control of a DOCUMENT if the PERSON has  
7 any ownership, possession, or custody of the DOCUMENT, or the right to secure  
8 the DOCUMENT or a copy thereof from any PERSON or public or private entity  
9 having physical possession thereof.

10 H. “RELATE,” “RELATED,” or “RELATING” as used herein means  
11 consisting of, referring to, reflecting, relating to, or being in any way logically or  
12 factually connected with the matter discussed.

13 I. “COMPLAINT” as used herein means the operative First Amended  
14 Complaint in the case *Edie Golikov v. Walmart Inc.*, filed on December 30, 2024  
15 (ECF No. 31), in the United States District Court for the District of Central  
16 California, Case No. 2:24-cv-08211.

17 J. The terms “and” and “or” shall be construed either conjunctively or  
18 disjunctively as necessary to bring within the scope of the request all responses that  
19 might otherwise fall outside the scope of the request.

20 K. The terms “all,” “any,” “each,” and “every” encompass any and all of  
21 the matter discussed.

22 L. The use of singular form includes plural, and vice versa.

23 M. The use of present tense includes past tense, and vice versa.

## 24 **INSTRUCTIONS**

25 1. YOU are requested to produce for inspection and copying all  
26 responsive documents and things in YOUR possession, custody or control,  
27 including all documents and things in the custody of YOUR attorneys, consultants,  
28

1 agents, other representatives, and other persons or entities subject to YOUR  
2 control.

3 2. YOU are to produce the documents and things as they are kept in the  
4 ordinary course of business, with appropriate markings or designations so that it  
5 may be determined to which request they are responsive.

6 3. YOU are to produce the original and all non-identical copies of each  
7 requested document or thing, including all copies which bear any additional file  
8 stamps, marginal notes or other additional markings or writings that do not appear  
9 on the original.

10 4. Documents shall be produced with a Concordance-style load file (.dat)  
11 along with extracted text and single-page image files (TIFF/JPG). For Documents  
12 whose native format is MS Excel, MS Access, other database formats, audio/video,  
13 or any other file type that cannot be converted to TIFF, the original native files  
14 should be produced in addition to a single-page TIFF placeholder. To the extent  
15 possible, each file should be accompanied with one corresponding text file. The text  
16 files should be produced separately, and not included in the load files.

17 5. If YOU cannot fully respond to any request after a diligent attempt,  
18 respond to the request to the extent possible and specify the portion of the request to  
19 which YOU are unable to respond.

20 6. If YOU claim that any request, definition or instruction is ambiguous,  
21 state the language YOU claim is ambiguous and the interpretation YOU have used  
22 to respond to the request.

23 7. If YOU contend that any document or thing has been lost or destroyed,  
24 set forth the contents of the document or thing, the location of any copies, the date  
25 of loss or destruction, the name of the person who ordered or authorized the  
26 destruction, if any, and the authority and reasons for such destruction.

27 8. If YOU decline to produce any information, document, or thing on the  
28 basis of the attorney-client, work product, or other privilege, respond to so much of

1 the discovery request as is not subject to the claimed objection, and for each  
2 document or thing YOU are withholding, provide the following information:

- 3 a. the type and title of the document or thing;
- 4 b. the general subject matter of the document or description of the  
5 thing;
- 6 c. the date of its creation;
- 7 d. the identity of the document's author(s), addressee(s) and  
8 recipient(s);
- 9 e. the nature of the privilege being claimed; and
- 10 f. in detail, all facts upon which YOU base YOUR claim of privilege

11 9. If YOU consider any Request or portion of a Request objectionable,  
12 state the specific ground for the objection. If that objection applies to only a portion  
13 or portions of the Request, answer to the fullest extent possible the portions to  
14 which You have raised no objection.

### 15 16 **REQUESTS FOR PRODUCTION**

#### 17 **REQUEST FOR PRODUCTION NO. 1:**

18 All DOCUMENTS and COMMUNICATIONS that RELATE to any  
19 transaction between YOU and WALMART on or after September 24, 2020.

#### 20 **REQUEST FOR PRODUCTION NO. 2:**

21 All DOCUMENTS and COMMUNICATIONS that RELATE to any  
22 transaction between YOU and a VENDOR on or after September 24, 2020.

#### 23 **REQUEST FOR PRODUCTION NO. 3:**

24 All DOCUMENTS and COMMUNICATIONS that RELATE to YOUR  
25 purchase of the PRODUCT(S), including but not limited to receipts or bank  
26 statements reflecting such purchase.

**REQUEST FOR PRODUCTION NO. 4:**

All DOCUMENTS and COMMUNICATIONS that RELATE to where YOU purchased the PRODUCT(S), including from online personal grocery shipping services (e.g., Instacart, DoorDash, Uber Eats, Postmates, GrubHub, Amazon Flex, Caviar, Shipt, Favor, and ChowNow), or on the Walmart.com website, from September 24, 2020 to the present.

**REQUEST FOR PRODUCTION NO. 5:**

All DOCUMENTS and COMMUNICATIONS that RELATE to when YOU purchased the PRODUCT(S), from September 24, 2020 to the present.

**REQUEST FOR PRODUCTION NO. 6:**

All DOCUMENTS and COMMUNICATIONS that RELATE to any materials YOU relied upon in making YOUR purchase of the PRODUCT(S), from September 24, 2020 to the present.

**REQUEST FOR PRODUCTION NO. 7:**

All DOCUMENTS and COMMUNICATIONS that RELATE to the PRODUCT(S).

**REQUEST FOR PRODUCTION NO. 8:**

All club, membership, loyalty, and/or rewards cards, including but not limited to any Walmart+ membership, YOU have had with WALMART.

**REQUEST FOR PRODUCTION NO. 9:**

All labels, packaging, advertisements, and marketing materials for the PRODUCT(S) from September 24, 2020 to the present.

**REQUEST FOR PRODUCTION NO. 10:**

The physical bottle and packaging of the PRODUCT(S) YOU purchased from September 24, 2020 to the present.

**REQUEST FOR PRODUCTION NO. 11:**

Any pictures or photographs YOU have of the physical packaging of the PRODUCT(S) YOU purchased from September 24, 2020 to the present.

**REQUEST FOR PRODUCTION NO. 12:**

All DOCUMENTS and COMMUNICATIONS that evidence, refer to, or concern any request for a refund YOU made for any WALMART product YOU purchased, from September 24, 2020 to the present.

**REQUEST FOR PRODUCTION NO. 13:**

All DOCUMENTS that RELATE to any COMMUNICATION between YOU and any representative of WALMART concerning the PRODUCT(S).

**REQUEST FOR PRODUCTION NO. 14:**

All DOCUMENTS that RELATE to any COMMUNICATION between YOU and any representative of a VENDOR concerning the PRODUCT(S).

**REQUEST FOR PRODUCTION NO. 15:**

All DOCUMENTS RELATED TO any COMMUNICATIONS YOU have had with any governmental agency, including but not limited to the Food and Drug Administration, that evidence, support, refer, or RELATE TO any of the matters alleged in YOUR COMPLAINT.

**REQUEST FOR PRODUCTION NO. 16:**

All DOCUMENTS that RELATE to any COMMUNICATION between YOU and any PERSON (other than privileged COMMUNICATIONS with YOUR attorneys in this action) concerning the PRODUCT, from September 24, 2020 to the present.

**REQUEST FOR PRODUCTION NO. 17:**

All DOCUMENTS that RELATE to any COMMUNICATION between YOU or YOUR attorney(s) or other representative(s) and any other member of the proposed class YOU seek to represent, regarding the subject matter of the COMPLAINT.



**REQUEST FOR PRODUCTION NO. 18:**

All DOCUMENTS that RELATE to any COMMUNICATION between YOU or any other potential plaintiff in this action that purchased the PRODUCT(S).

**REQUEST FOR PRODUCTION NO. 19:**

All DOCUMENTS and COMMUNICATIONS, including without limitation, correspondence, notes of telephone conversations and electronic mail, referring or RELATING to any COMMUNICATION between YOU or YOUR attorney(s) or other representative(s) and any other members of the proposed class you seek to represent, regarding WALMART.

**REQUEST FOR PRODUCTION NO. 20:**

All DOCUMENTS and COMMUNICATIONS, including without limitation, correspondence, notes of telephone conversations and electronic mail, referring or RELATING to any COMMUNICATION between YOU or YOUR attorney(s) or other representative(s) and any other members of the proposed class you seek to represent, regarding a VENDOR.

**REQUEST FOR PRODUCTION NO. 21:**

All DOCUMENTS that evidence, refer to, or concern any COMMUNICATION that YOU or YOUR attorney(s) or other representative(s) made or received RELATING to WALMART or the PRODUCT(S) at issue in the COMPLAINT, on any publicly accessible medium, including without limitation, Internet websites, social networking sites, news groups, chat rooms, and online services (such as Facebook, Instagram, Twitter, or LinkedIn).

**REQUEST FOR PRODUCTION NO. 22:**

All DOCUMENTS that evidence, refer to, or concern any COMMUNICATION that YOU or YOUR attorney(s) or other representative(s) made or received RELATING to a VENDOR, on any publicly accessible medium, including without limitation, Internet websites, social networking sites, news

groups, chat rooms, and online services (such as Facebook, Instagram, Twitter, or LinkedIn).

**REQUEST FOR PRODUCTION NO. 23:**

All DOCUMENTS that RELATE to any COMMUNICATION, whether written or oral, between YOU and any potential class members.

**REQUEST FOR PRODUCTION NO. 24:**

All DOCUMENTS RELATED to any COMMUNICATIONS YOU have had with any PERSONS, including potential class members, that evidence, discuss, support, refer, or RELATE to any of the matters alleged in the COMPLAINT, including ANY written or recorded statements YOU have taken from anyone RELATING to any of the claims, defenses, contentions, allegations, or facts in this litigation.

**REQUEST FOR PRODUCTION NO. 25:**

All DOCUMENTS that RELATE to the manner in which YOU became a party to this action, including but not limited to advertisements or news articles, solicitations, emails, notices, or correspondence to which YOU responded.

**REQUEST FOR PRODUCTION NO. 26:**

All DOCUMENTS that RELATE to any relationship YOU have with any attorney, staff member, and/or family of any attorney or staff member at Dovel & Luner, LLP, including but not limited to representation agreement(s) and fee arrangement(s).

**REQUEST FOR PRODUCTION NO. 27:**

All DOCUMENTS and COMMUNICATIONS RELATING to YOUR allegation in Paragraph 28 of YOUR COMPLAINT that YOU “ha[ve] no adequate remedy at law.”

**REQUEST FOR PRODUCTION NO. 28:**

All DOCUMENTS and COMMUNICATIONS RELATING to YOUR allegation in Paragraph 33 of YOUR COMPLAINT that “[t]he proposed class

contains members so numerous that separate joinder of each member of the class is impracticable.”

**REQUEST FOR PRODUCTION NO. 29:**

All DOCUMENTS and COMMUNICATIONS RELATING to YOUR allegation in Paragraph 36 of YOUR COMPLAINT that YOUR “claims are typical of the proposed class.”

**REQUEST FOR PRODUCTION NO. 30:**

All DOCUMENTS and COMMUNICATIONS RELATING to YOUR allegation in Paragraph 36 of YOUR COMPLAINT that “[t]here are no conflicts of interest between [YOU] and the class.”

**REQUEST FOR PRODUCTION NO. 31:**

All DOCUMENTS and COMMUNICATIONS RELATING to YOUR allegation in Paragraph 37 of YOUR COMPLAINT that “[a] class action is superior to all other available methods for the fair and efficient adjudication of this litigation because individual litigation is impractical.”

**REQUEST FOR PRODUCTION NO. 32:**

All DOCUMENTS and COMMUNICATIONS RELATING to actual or potential conflicts of interest YOU may have with putative or purported class members that make up the alleged class as pled in YOUR COMPLAINT.

**REQUEST FOR PRODUCTION NO. 33:**

All DOCUMENTS that RELATE to any representations, agreements, promises or assurances YOU received about any monetary recovery YOU might receive as a result of YOUR participation as a plaintiff in this lawsuit.

**REQUEST FOR PRODUCTION NO. 34:**

All DOCUMENTS that RELATE to any agreement YOU have with YOUR attorneys, or any other PERSON or entity, or any agreement YOUR attorneys have with any other PERSON or entity, concerning:

- i. the payment or advancement of attorneys' fees, expenses, and costs with respect to this lawsuit;
- ii. who will advance, and who is responsible for, payment of the costs and expenses incurred in connection with the prosecution of this lawsuit; or
- iii. whether a fee in this lawsuit will be shared with any PERSON not a member of YOUR attorneys' law firms.

**REQUEST FOR PRODUCTION NO. 35:**

All DOCUMENTS and COMMUNICATIONS RELATING to YOUR allegation in Paragraph 19 of YOUR COMPLAINT that "[n]o reasonable consumer expects that a bottle labeled 'Avocado Oil,' featuring photos of avocados, and listing only 'avocado oil' as its ingredient contains other, cheaper, non-avocado oils."

**REQUEST FOR PRODUCTION NO. 36:**

All DOCUMENTS and COMMUNICATIONS RELATING to YOUR allegation in Paragraph 20 of YOUR COMPLAINT that the PRODUCT(S) "contains high levels of other oils, including oleic sunflower or safflower oils."

**REQUEST FOR PRODUCTION NO. 37:**

All DOCUMENTS and COMMUNICATIONS RELATING to YOUR allegation in Paragraph 21 of YOUR COMPLAINT that "consumers choose to pay more for avocado oil products, because they believe that the products that they are receiving are unadulterated avocado oil, and not an oil that is adulterated with cheaper oils."

**REQUEST FOR PRODUCTION NO. 38:**

All DOCUMENTS and COMMUNICATIONS RELATING to YOUR allegation in Paragraph 22 of YOUR COMPLAINT that the "Defendant knows, or reasonably should know, that its labeling is misleading customers."

**REQUEST FOR PRODUCTION NO. 39:**

All DOCUMENTS and COMMUNICATIONS RELATING to YOUR allegation in Paragraph 24 of YOUR COMPLAINT that “if Defendant accurately labeled its Product, consumers would not have purchased the Products or would have paid less for the Products.”

**REQUEST FOR PRODUCTION NO. 40:**

All DOCUMENTS and COMMUNICATIONS RELATING to YOUR allegation in Paragraph 25 of YOUR COMPLAINT that YOU “paid for a superior product worth more, and received an inferior product that was inaccurately labeled.”

**REQUEST FOR PRODUCTION NO. 41:**

All DOCUMENTS and COMMUNICATIONS RELATING to YOUR allegation in Paragraph 26 of YOUR COMPLAINT that YOU “would not have purchased the Product if [YOU] had known that the Product was contaminated with other oils, or [YOU] would have paid less for it.”

**REQUEST FOR PRODUCTION NO. 42:**

All DOCUMENTS and COMMUNICATIONS RELATING to YOUR allegation in Paragraph 26 of YOUR COMPLAINT that “[t]he package prominently stated ‘Avocado Oil’ and had pictures of avocados, “[t]he ingredient list also listed only avocado oil,” and that YOU “read and relied on these statements when purchasing the Product.”

**REQUEST FOR PRODUCTION NO. 43:**

All DOCUMENTS and COMMUNICATIONS RELATING to YOUR allegation in Paragraph 27 of YOUR COMPLAINT that “[i]f Walmart fixes their Products, so that the avocado oil is actually unadulterated and not contaminated with other oils, [YOU] would buy them again.”



**REQUEST FOR PRODUCTION NO. 44:**

All DOCUMENTS and COMMUNICATIONS RELATING to YOUR contention that the PRODUCT is adulterated, impure, or not avocado oil, including but not limited to all DOCUMENTS and COMMUNICATIONS YOU contend show or suggest the PRODUCT is adulterated, impure, or not avocado oil.

**REQUEST FOR PRODUCTION NO. 45:**

All DOCUMENTS and COMMUNICATIONS regarding YOUR purchase of any avocado oil, aside from the PRODUCT, from September 24, 2020 to the present.

**REQUEST FOR PRODUCTION NO. 46:**

All DOCUMENTS and COMMUNICATIONS REGARDING when YOU became aware that the PRODUCT(S) were adulterated, impure, or not entirely avocado oil.

**REQUEST FOR PRODUCTION NO. 47:**

All DOCUMENTS and COMMUNICATIONS REGARDING when YOU became aware that avocado oil sold in retail stores might be adulterated, impure, or not entirely avocado oil.

**REQUEST FOR PRODUCTION NO. 48:**

All DOCUMENTS and COMMUNICATIONS RELATING to any economic or other injury YOU claim to have sustained as a result of any of WALMART's acts, representations, or omissions alleged in the COMPLAINT.

**REQUEST FOR PRODUCTION NO. 49:**

All DOCUMENTS and COMMUNICATIONS RELATING to any economic or other injury YOU claim to have sustained as a result of any VENDOR's acts, representations, or omissions alleged in the COMPLAINT.

**REQUEST FOR PRODUCTION NO. 50:**

All DOCUMENTS on which YOU intend to rely in support of YOUR claims or alleged damages in YOUR COMPLAINT.

**REQUEST FOR PRODUCTION NO. 51:**

All curriculum vitae or resumes of any expert who may offer evidence in support of class certification, at trial or with respect to any other motion in this lawsuit that is the subject of YOUR COMPLAINT and copies of all publications, reports, presentations or other documents referred to on the curriculum vitae or resume of each such expert.

**REQUEST FOR PRODUCTION NO. 52:**

All DOCUMENTS that RELATE to any compensation or consideration to be given to any expert who may offer evidence in support of class certification, at trial or with respect to any other motion in this lawsuit, including but not limited to retention agreements, invoices, and proof of payment.

**REQUEST FOR PRODUCTION NO. 53:**

All expert reports and transcripts of depositions, hearings, and trial testimony given or written within the preceding four years, in any matter, by any expert who may offer evidence in support of class certification, at trial or with respect to any other motion in this lawsuit.

**REQUEST FOR PRODUCTION NO. 54:**

All DOCUMENTS currently in YOUR possession that YOU intend to introduce at the deposition of any representative, agent, officer, employee of WALMART.

**REQUEST FOR PRODUCTION NO. 55:**

All non-privileged DOCUMENTS that RELATE to each occasion YOU have participated as a class representative in any other lawsuit.

**REQUEST FOR PRODUCTION NO. 56:**

All DOCUMENTS that RELATE to any legal proceedings commenced at any time in any court or with any arbitration organization in which YOU have sought to be a class representative in a class action, in which YOU brought suit derivatively on behalf of a corporation, or in which YOU represented or assisted in

1 the representation of any plaintiffs, defendants, or other PERSONS in a legal  
2 proceeding brought as a class, derivative or private attorney general action.

3 **REQUEST FOR PRODUCTION NO. 57:**

4 All DOCUMENTS evidencing, referring or RELATING to any other actions,  
5 lawsuits, arbitrations, bankruptcies, insolvency proceedings or other adjudicatory  
6 proceedings or regulatory enforcement actions or investigations to which YOU are  
7 or have been a party during the past ten years.

8 **REQUEST FOR PRODUCTION NO. 58:**

9 All DOCUMENTS and COMMUNICATIONS evidencing or supporting  
10 YOUR testimony that YOU “purchased bottles of Great Value Avocado Oil from a  
11 Walmart store while living in Tarzana, California” and “paid approximately \$8.23  
12 for each bottle,” as stated in Paragraph 2 of YOUR December 27, 2024 Declaration  
13 filed in support of YOUR Motion for Class Certification (ECF 36-1).

14 **REQUEST FOR PRODUCTION NO. 59:**

15 All DOCUMENTS and COMMUNICATIONS evidencing or supporting  
16 YOUR testimony that YOU “believed that Great Value Avocado Oil contained  
17 unadulterated avocado oil” as stated in Paragraph 3 of YOUR December 27, 2024  
18 Declaration filed in support of YOUR Motion for Class Certification (ECF 36-1).

19 **REQUEST FOR PRODUCTION NO. 60:**

20 All DOCUMENTS and COMMUNICATIONS evidencing or supporting  
21 YOUR testimony that YOU “do not know of or foresee any conflicts of interest  
22 between [yourself] and any other class members,” as stated in Paragraph 5 of  
23 YOUR December 27, 2024 Declaration filed in support of YOUR Motion for Class  
24 Certification (ECF 36-1).

25 **REQUEST FOR PRODUCTION NO. 61:**

26 All DOCUMENTS and COMMUNICATIONS evidencing or supporting  
27 YOUR testimony that “Had [YOU] known that the products were adulterated,  
28 [YOU] would not have purchased them or would have paid the price [YOU] paid

1 for them,” as stated in Paragraph 4 of YOUR December 27, 2024 Declaration filed  
2 in support of YOUR Motion for Class Certification (ECF 36-1).

3 **REQUEST FOR PRODUCTION NO. 62:**

4 All DOCUMENTS and COMMUNICATIONS evidencing or supporting  
5 YOUR testimony that YOU “have actively participated in this case,” as stated in  
6 Paragraph 6 of YOUR December 27, 2024 Declaration filed in support of YOUR  
7 Motion for Class Certification (ECF 36-1).

8 **REQUEST FOR PRODUCTION NO. 63:**

9 All DOCUMENTS and COMMUNICATIONS REGARDING the  
10 “additional testing” performed by Ceutical Labs “on a sample of Great Value  
11 Avocado Oil,” as described in Paragraph 15 of the Declaration of Richard Lyon  
12 dated January 8, 2025 (ECF No. 36-3) and as described in the Declaration of Imel  
13 Courtland (ECF No. 41-1), including but not limited to the testing results attached  
14 as Exhibit 11 to the Declaration.

15 **REQUEST FOR PRODUCTION NO. 64:**

16 The bottle(s) of PRODUCT, including any “sample,” tested by Ceutical Labs  
17 as described in Paragraph 15 of the Declaration of Richard Lyon dated January 8,  
18 2025 (ECF No. 36-3).

19 **REQUEST FOR PRODUCTION NO. 65:**

20 All DOCUMENTS and COMMUNICATIONS supporting or evidencing the  
21 “prices” of “Walmart’s cooking oil products from the Walmart website,” as  
22 described in Paragraph 2 of the Declaration of Richard Lyon dated January 8, 2025  
23 (ECF No. 36-3).

24 **REQUEST FOR PRODUCTION NO. 66:**

25 All DOCUMENTS and COMMUNICATIONS supporting or evidencing the  
26 contention that testing “results indicate that the tested oil is adulterated with some  
27 other oil that is not avocado oil” and “reveal that the indicat[e] that the sample was  
28

1 adulterated with oils other than avocado oil” in Paragraphs 4 and 7 of the  
2 Declaration of Imel Courtland (ECF No. 41-1).

3 **REQUEST FOR PRODUCTION NO. 67:**

4 All DOCUMENTS and COMMUNICATIONS supporting or evidencing the  
5 contention that testing “the sample” of the PRODUCT “is adulterated with oils  
6 other than avocado oil” in Paragraph 6 of the Declaration of Imel Courtland (ECF  
7 No. 41-1).

8 **REQUEST FOR PRODUCTION NO. 68:**

9 All DOCUMENTS and COMMUNICATIONS REGARDING any testing  
10 performed on the PRODUCTS, including but not limited to any testing by Ceutical  
11 Laboratories, Inc. or any other laboratory or facility.

12  
13  
14 Dated: January 23, 2025

DAVIS WRIGHT TREMAINE LLP

15 By:   
16 Jacob M. Harper

17 Attorneys for Defendant  
18 Walmart Inc.  
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**PROOF OF SERVICE**

STATE OF CALIFORNIA, COUNTY OF LOS ANGELES

I am employed in the County of Los Angeles, State of California. I am over the age of 18 and not a party to the within action; my business address is 350 South Grand Avenue, 27<sup>th</sup> Floor, Los Angeles, CA 90071.

On January 23, 2025, I served the document described as “**DEFENDANT WALMART INC.’S REQUESTS FOR PRODUCTION, SET ONE**” upon the interested parties in this action addressed as follows:

PLEASE SEE ATTACHED SERVICE LIST

  X   (VIA U.S. MAIL) I placed such envelope(s) with postage thereon fully prepaid for deposit in the United States Mail in accordance with the office practice of Davis Wright Tremaine LLP, for collecting and processing correspondence for mailing with the United States Postal Service. I am familiar with the office practice of Davis Wright Tremaine LLP, for collecting and processing correspondence for mailing with the United States Postal Service, which practice is that when correspondence is deposited with the Davis Wright Tremaine LLP, personnel responsible for delivering correspondence to the United States Postal Service, such correspondence is delivered to the United States Postal Service that same day in the ordinary course of business.

       (VIA PERSONAL SERVICE) I caused the above-named documents to be served on all other parties to this action by requesting that a messenger from GLOBAL NETWORK LEGAL SUPPORT deliver true copies of the above-named documents enclosed in sealed envelopes.

1 X (VIA EMAIL) By forwarding a portable document file to the electronic mail  
2 address(es) below from electronic mail address linapearmain@dwt.com, at  
3 350 South Grand Avenue, 27<sup>th</sup> Floor, Los Angeles, CA.

4 \_\_\_\_\_ (VIA OVERNIGHT DELIVERY) by placing a true copy or original in a  
5 separate envelope for each addressee named above, with the name and  
6 address of the person served shown above on the envelope, sealing the  
7 envelope and placing it for collection and delivery by FEDERAL EXPRESS  
8 with delivery fees paid or provided for in accordance with ordinary business  
9 practices.  
10

11 Executed on January 23, 2025, Los Angeles, California.

12 X Federal I declare under penalty of perjury under the laws of the United States  
13 of America that the foregoing is true and correct and that I am employed in  
14 the office of a member of the bar of this Court at whose direction the service  
15 was made.  
16

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18 \_\_\_\_\_  
19 LINA PEARMAN  
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**SERVICE LIST**

<b>DOVEL &amp; LUNER, LLP</b> Richard Lyon Stephen D. Andrews Christin Cho 201 Santa Monica Blvd., Suite 600 Santa Monica, California 90401 Telephone: (310) 656-7066 Email: <a href="mailto:rick@dovel.com">rick@dovel.com</a> Email: <a href="mailto:stephen@dovel.com">stephen@dovel.com</a> Email: <a href="mailto:christin@dovel.com">christin@dovel.com</a>	<i>Attorneys for Plaintiff Edie Golikov</i>
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# **EXHIBIT H**

1 Richard Lyon (Cal Bar No. 229288)  
2 rick@dovel.com  
3 Christin Cho (Cal. Bar No. 238173)  
4 christin@dovel.com  
5 DOVEL & LUNER, LLP  
6 201 Santa Monica Blvd., Suite 600  
7 Santa Monica, California 90401  
8 Telephone: (310) 656-7066  
9 Facsimile: (310) 656-7069

*Attorney for Plaintiff*

10 **UNITED STATES DISTRICT COURT**  
11 **CENTRAL DISTRICT OF CALIFORNIA**

12 EDIE GOLIKOV, individually and  
13 on behalf of all others similarly  
14 situated,

15 *Plaintiff,*

16 v.

17 WALMART INC.,

18 *Defendant.*  
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Case No. 2:24-cv-08211-RGK-MAR

**PLAINTIFF'S RESPONSE TO  
DEFENDANT WALMART INC.'S  
FIRST SET OF REQUESTS FOR  
PRODUCTION**



1 Pursuant to Federal Rule of Civil Procedure 34, Plaintiff Edie Golikov (“Plaintiff”)  
2 provides the following objections and responses to Defendant’s first set of requests for  
3 the production of documents.

4 Plaintiff responds based on information currently known and available to Plaintiff  
5 and her counsel as of the date of these objections and responses. Pursuant to the Federal  
6 Rules of Civil Procedure and applicable law, when Plaintiff agrees to produce documents,  
7 Plaintiff will only produce documents in her possession, custody or control and that can  
8 be located after a reasonable search. Plaintiff’s agreement to produce responsive  
9 documents does not mean that any responsive documents exist.

10 Plaintiff may amend or supplement these responses as additional discovery is taken,  
11 facts are learned, research is completed, and arguments are made.

12 Plaintiff objects to the extent that any request for production requests information  
13 that is protected from discovery by the attorney-client privilege, the work product  
14 doctrine, the common interest privilege, and/or any other applicable privilege or other  
15 immunity. Plaintiff will not provide privileged information or work product.

16 Plaintiff will respond as required by the Federal Rules of Civil Procedure, the Local  
17 Rules of this Court, and this Court’s orders, but will not comply with any instructions that  
18 exceed those requirements.

19 **General Objections**

20 Plaintiff provides these Responses in good faith based on her investigation to date.  
21 Plaintiff will continue her investigation, analysis, discovery, and legal research, and  
22 reserves the right to rely on facts, documents, legal research, or other evidence that might  
23 come to her attention at a later time. Plaintiff sets forth these objections and responses  
24 without prejudice to her right to supplement or amend them, or to assert additional  
25 objections should she discover additional information or grounds for objection. Plaintiff  
26 specifically reserves the right to supplement or amend these objections and responses any  
27 time before trial.

1 Any response that Plaintiff will produce documents should not be taken as a  
2 representation that such documents exist, but rather as an undertaking to locate and  
3 produce relevant, non-privileged documents, if they exist and can be found through a  
4 reasonable search, without undue burden, in the files maintained in the ordinary course  
5 of business, if any, that are likely to contain the requested information. Plaintiff reserves  
6 the right to assert attorney-client privilege and/or work product protection on any  
7 documents or information inadvertently produced in response to these Requests. By  
8 producing documents, Plaintiff does not waive and specifically reserves her right to  
9 contest the admissibility or relevance of such documents. Further, any inadvertent  
10 disclosure and production of information that is not relevant or is subject to other  
11 objection(s) does not waive any objection to producing such documents or to producing  
12 additional or related documents.

13 The presence of any objection to one of the Requests does not necessarily indicate  
14 that documents responsive thereto have been withheld or will be withheld from  
15 discovery. As to the Requests to which Plaintiff objects, Plaintiff is willing to discuss each  
16 of the Requests with Defendant's counsel to determine whether any or all of the  
17 objections can be satisfied or the Requests can be clarified or narrowed.

18 Plaintiff makes the following general objections to Defendant's definitions, and  
19 requests for production, whether or not the objections are also separately set forth in  
20 response to each definition or request for production. By undertaking to produce  
21 documents in response to any particular request, Plaintiff does not represent that  
22 responsive documents exist, or that any such documents are within her possession,  
23 custody or control. Plaintiff will produce responsive documents that can be found and  
24 normally expected to be kept in accordance with her usual practices and behavior.

25 Specific objections to Defendant's requests are set forth in the individual  
26 responses below. In addition to such specific objections, Plaintiff makes the following  
27 general objections, which apply to all of Defendant's requests.  
28

1           1.     Plaintiff objects to Defendant's requests to the extent they seek information  
2 protected by, immune from, or otherwise exempt from discovery by the attorney-client  
3 privilege, common interest privilege or any other privilege, the work-product doctrine, or  
4 any applicable state or federal statutes, the Federal Rules of Civil Procedure, the Local  
5 Rules of the Central District of California, or any other applicable rule, decision, or law.  
6 The specific objections stated below on the grounds of attorney-client privilege and/or  
7 work-product doctrine in no way limit the applicability of this objection to all requests.  
8 Nothing contained in the responses below is intended to be, nor should be considered, a  
9 waiver of any attorney-client privilege and/or work-product doctrine, right of privacy, or  
10 any other applicable privilege or doctrine. Inadvertent disclosure of any information that  
11 is confidential, privileged, that was prepared in anticipation of litigation or for trial, or is  
12 otherwise immune from discovery, shall not constitute a waiver of any privilege or any  
13 ground for objection to discovery with respect to such information, or of Plaintiff's right  
14 to object to the use of any such information during this or any subsequent proceeding.

15           2.     Plaintiff objects to Defendant's requests to the extent they seek information  
16 that is beyond the scope of discovery as permitted by the Federal Rules of Civil  
17 Procedure, the Local Rules of the Central District of California, or other applicable rules  
18 or law.

19           3.     Plaintiff objects to Defendant's definitions and requests for production as  
20 being overly broad and unduly burdensome to the extent that they seek the disclosure of  
21 information existing in the public domain and/or in the possession, custody, or control  
22 of an entity other than Plaintiff. Such information is as available to Defendant as it is to  
23 Plaintiff.

24           4.     Plaintiff objects to Defendant's Requests to the extent they request  
25 irrelevant information or information that is not reasonably calculated to lead to the  
26 discovery of admissible evidence.

27           5.     Plaintiff objects to Defendant's definitions and requests for production to  
28 the extent they are vague, ambiguous, overly broad, duplicative, fail to reasonably identify

1 the information sought, unduly burdensome, and posed for improper purposes,  
2 including, without limitation, embarrassment, undue annoyance, harassment, delay, or to  
3 increase the expense of litigation or to the extent they call for a legal conclusion or  
4 opinion.

5 6. Plaintiff object to Defendant's Requests to the extent they request  
6 information for time periods beyond those relevant to the issues in this lawsuit on the  
7 ground that such Requests are overly broad, unduly burdensome and without merit or  
8 foundation and therefore seek information that is not relevant to this lawsuit, and is not  
9 reasonably calculated to lead to the discovery of admissible evidence.

10 7. Plaintiff objects to Defendant's Requests to the extent they seek documents  
11 that contain confidential information, including confidential information of third parties.

12 8. Plaintiff objects to the definitions of "You" and "Your" on the grounds that  
13 they are overly broad, not limited to the named plaintiff in the present litigation, will  
14 result in overly burdensome responses, and purport to include Plaintiff's counsel.  
15 Plaintiff will define these terms to include herself.

16 9. Plaintiff objects to the definitions of "RELATE," "RELATED," AND  
17 "RELATING" on the grounds that they are overly broad, and incorporate within their  
18 scope information that is not relevant to this lawsuit, and is not reasonably calculated to  
19 lead to the discovery of admissible evidence.

20 Plaintiff incorporates each of the foregoing General Responses and Objections in  
21 each response to the individually numbered requests for production as if they were stated  
22 in each response.

23  
24  
25  
26  
27  
28 **Objections and Responses to each Request for Production**

**REQUEST NO. 1:**

All DOCUMENTS and COMMUNICATIONS that RELATE to any transaction between YOU and WALMART on or after September 24, 2020.

**RESPONSE:**

Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff objects to this request to the extent it asks Plaintiff to disclose work product or other privileged information. Plaintiff will not provide privileged information. Subject to these Objections, Plaintiff will produce any non-privileged, documents that can be located after a reasonable search that concern any transaction between Plaintiff and Walmart concerning Avocado Oil.

**REQUEST NO. 2:**

All DOCUMENTS and COMMUNICATIONS that RELATE to any transaction between YOU and a VENDOR on or after September 24, 2020.

**RESPONSE:**

Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff objects to this request to the extent it asks Plaintiff to disclose work product or other privileged information. Plaintiff will not provide privileged information. Subject to these Objections, Plaintiff will produce any non-privileged, documents reasonably responsive to this request that can be located after a reasonable search.

**REQUEST NO. 3:**

All DOCUMENTS and COMMUNICATIONS that RELATE to YOUR purchase of the PRODUCT(S), including but not limited to receipts or bank statements reflecting such purchase.

**RESPONSE:**

Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff objects to this request to the extent it asks Plaintiff to disclose work product or other privileged information. Plaintiff will not provide privileged information. Subject to these



1 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
2 to this request that can be located after a reasonable search.

3 **REQUEST NO. 4:**

4 All DOCUMENTS and COMMUNICATIONS that RELATE to where YOU purchased  
5 the PRODUCT(S), including from online personal grocery shipping services (e.g.,  
6 Instacart, DoorDash, Uber Eats, Postmates, GrubHub, Amazon Flex, Caviar, Shipt,  
7 Favor, and ChowNow), or on the Walmart.com website, from September 24, 2020 to the  
8 present.

9 **RESPONSE:**

10 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
11 objects to this request to the extent it asks Plaintiff to disclose work product or other  
12 privileged information. Plaintiff will not provide privileged information. Subject to these  
13 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
14 to this request that can be located after a reasonable search.

15 **REQUEST NO. 5:**

16 All DOCUMENTS and COMMUNICATIONS that RELATE to when YOU purchased  
17 the PRODUCT(S), from September 24, 2020 to the present.

18 **RESPONSE:**

19 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
20 objects to this request to the extent it asks Plaintiff to disclose work product or other  
21 privileged information. Plaintiff will not provide privileged information. Subject to these  
22 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
23 to this request that can be located after a reasonable search.

24 **REQUEST NO. 6:**

25 All DOCUMENTS and COMMUNICATIONS that RELATE to any materials YOU  
26 relied upon in making YOUR purchase of the PRODUCT(S), from September 24, 2020  
27 to the present.  
28

1 **RESPONSE:**

2 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
3 objects to this request to the extent it asks Plaintiff to disclose work product or other  
4 privileged information. Plaintiff will not provide privileged information. Subject to these  
5 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
6 to this request that can be located after a reasonable search.

7 **REQUEST NO. 7:**

8 All DOCUMENTS and COMMUNICATIONS that RELATE to the PRODUCT(S).

9 **RESPONSE:**

10 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
11 objects to this request to the extent it asks Plaintiff to disclose work product or other  
12 privileged information. Plaintiff will not provide privileged information. Subject to these  
13 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
14 to this request that can be located after a reasonable search.

15 **REQUEST NO. 8:**

16 All club, membership, loyalty, and/or rewards cards, including but not limited to any  
17 Walmart+ membership, YOU have had with WALMART.

18 **RESPONSE:**

19 Plaintiff incorporates the General Objections recited above as if fully stated here. Subject  
20 to these Objections, Plaintiff will produce any non-privileged, documents reasonably  
21 responsive to this request that can be located after a reasonable search.

22 **REQUEST NO. 9:**

23 All labels, packaging, advertisements, and marketing materials for the PRODUCT(S) from  
24 September 24, 2020 to the present.

25 **RESPONSE:**

26 Plaintiff incorporates the General Objections recited above as if fully stated here. Subject  
27 to these Objections, Plaintiff will produce any non-privileged, documents reasonably  
28 responsive to this request that can be located after a reasonable search.

1 **REQUEST NO. 10:**

2 The physical bottle and packaging of the PRODUCT(S) YOU purchased from September  
3 24, 2020 to the present.

4 **RESPONSE:**

5 Plaintiff incorporates the General Objections recited above as if fully stated here. Subject  
6 to these Objections, if Plaintiff locates any bottles or packaging responsive to this request  
7 after a reasonable search, Plaintiff will produce photographs of the bottles and packaging  
8 and confer with Defendant about inspection.

9 **REQUEST NO. 11:**

10 Any pictures or photographs YOU have of the physical packaging of the PRODUCT(S)  
11 YOU purchased from September 24, 2020 to the present.

12 **RESPONSE:**

13 Plaintiff incorporates the General Objections recited above as if fully stated here. Subject  
14 to these Objections, Plaintiff will produce any non-privileged, documents reasonably  
15 responsive to this request that can be located after a reasonable search.

16 **REQUEST NO. 12:**

17 All DOCUMENTS and COMMUNICATIONS that evidence, refer to, or concern any  
18 request for a refund YOU made for any WALMART product YOU purchased, from  
19 September 24, 2020 to the present.

20 **RESPONSE:**

21 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
22 objects to this request to the extent it asks Plaintiff to disclose work product or other  
23 privileged information. Plaintiff will not provide privileged information. Subject to these  
24 Objections, Plaintiff will produce any non-privileged, documents that can be located after  
25 a reasonable search that evidence, refer to, or concern any request for a refund Plaintiff  
26 made for any Avocado Oil product Plaintiff purchased from Walmart from September  
27 24, 2020 to the present.

**REQUEST NO. 13:**

All DOCUMENTS that RELATE to any COMMUNICATION between YOU and any representative of WALMART concerning the PRODUCT(S).

**RESPONSE:**

Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff objects to this request to the extent it asks Plaintiff to disclose work product or other privileged information. Plaintiff will not provide privileged information. Subject to these Objections, Plaintiff will produce any non-privileged, documents reasonably responsive to this request that can be located after a reasonable search.

**REQUEST NO. 14:**

All DOCUMENTS that RELATE to any COMMUNICATION between YOU and any representative of a VENDOR concerning the PRODUCT(S).

**RESPONSE:**

Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff objects to this request to the extent it asks Plaintiff to disclose work product or other privileged information. Plaintiff will not provide privileged information. Subject to these Objections, Plaintiff will produce any non-privileged, documents reasonably responsive to this request that can be located after a reasonable search.

**REQUEST NO. 15:**

All DOCUMENTS RELATED TO any COMMUNICATIONS YOU have had with any governmental agency, including but not limited to the Food and Drug Administration, that evidence, support, refer, or RELATE TO any of the matters alleged in YOUR COMPLAINT.

**RESPONSE:**

Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff objects to this request to the extent it asks Plaintiff to disclose work product or other privileged information. Plaintiff will not provide privileged information. Subject to these

1 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
2 to this request that can be located after a reasonable search.

3 **REQUEST NO. 16:**

4 All DOCUMENTS that RELATE to any COMMUNICATION between YOU and any  
5 PERSON (other than privileged COMMUNICATIONS with YOUR attorneys in this  
6 action) concerning the PRODUCT, from September 24, 2020 to the present.

7 **RESPONSE:**

8 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
9 objects to this request to the extent it asks Plaintiff to disclose work product or other  
10 privileged information. Plaintiff will not provide privileged information. Subject to these  
11 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
12 to this request that can be located after a reasonable search.

13 **REQUEST NO. 17:**

14 All DOCUMENTS that RELATE to any COMMUNICATION between YOU or  
15 YOUR attorney(s) or other representative(s) and any other member of the proposed class  
16 YOU seek to represent, regarding the subject matter of the COMPLAINT.

17 **RESPONSE:**

18 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
19 objects to this request to the extent it asks Plaintiff to disclose work product or other  
20 privileged information. Plaintiff will not provide privileged information. Subject to these  
21 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
22 to this request that can be located after a reasonable search.

23 **REQUEST NO. 18:**

24 All DOCUMENTS that RELATE to any COMMUNICATION between YOU or any  
25 other potential plaintiff in this action that purchased the PRODUCT(S).

26 **RESPONSE:**

27 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
28 objects to this request to the extent it asks Plaintiff to disclose work product or other



1 privileged information. Plaintiff will not provide privileged information. Subject to these  
2 Objections, Plaintiff will produce any non-privileged, documents that can be located after  
3 a reasonable search that concern or constitute any communications concerning the  
4 subject matter of this lawsuit, made between Plaintiff and any other potential plaintiff in  
5 this action that purchased the Product.

6 **REQUEST NO. 19:**

7 All DOCUMENTS and COMMUNICATIONS, including without limitation,  
8 correspondence, notes of telephone conversations and electronic mail, referring or  
9 RELATING to any COMMUNICATION between YOU or YOUR attorney(s) or other  
10 representative(s) and any other members of the proposed class you seek to represent,  
11 regarding WALMART.

12 **RESPONSE:**

13 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
14 objects to this request to the extent it asks Plaintiff to disclose work product or other  
15 privileged information. Plaintiff will not provide privileged information. Subject to these  
16 Objections, Plaintiff will produce any non-privileged, documents that can be located after  
17 a reasonable search that concern or constitute any communications concerning the  
18 subject matter of this lawsuit, made between Plaintiff and any other members of the  
19 proposed class.

20 **REQUEST NO. 20:**

21 All DOCUMENTS and COMMUNICATIONS, including without limitation,  
22 correspondence, notes of telephone conversations and electronic mail, referring or  
23 RELATING to any COMMUNICATION between YOU or YOUR attorney(s) or other  
24 representative(s) and any other members of the proposed class you seek to represent,  
25 regarding a VENDOR.

26 **RESPONSE:**

27 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
28 objects to this request to the extent it asks Plaintiff to disclose work product or other

1 privileged information. Plaintiff will not provide privileged information. Subject to these  
2 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
3 to this request that can be located after a reasonable search.

4 **REQUEST NO. 21:**

5 All DOCUMENTS that evidence, refer to, or concern any COMMUNICATION that  
6 YOU or YOUR attorney(s) or other representative(s) made or received RELATING to  
7 WALMART or the PRODUCT(S) at issue in the COMPLAINT, on any publicly  
8 accessible medium, including without limitation, Internet websites, social networking sites,  
9 news groups, chat rooms, and online services (such as Facebook, Instagram, Twitter, or  
10 LinkedIn).

11 **RESPONSE:**

12 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
13 objects to this request to the extent it asks Plaintiff to disclose work product or other  
14 privileged information. Plaintiff will not provide privileged information. Subject to these  
15 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
16 to this request that can be located after a reasonable search.

17 **REQUEST NO. 22:**

18 All DOCUMENTS that evidence, refer to, or concern any COMMUNICATION that  
19 YOU or YOUR attorney(s) or other representative(s) made or received RELATING to a  
20 VENDOR, on any publicly accessible medium, including without limitation, Internet  
21 websites, social networking sites, news groups, chat rooms, and online services (such as  
22 Facebook, Instagram, Twitter, or LinkedIn).

23 **RESPONSE:**

24 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
25 objects to this request to the extent it asks Plaintiff to disclose work product or other  
26 privileged information. Plaintiff will not provide privileged information. Subject to these  
27 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
28 to this request that can be located after a reasonable search.

1 **REQUEST NO. 23:**

2 All DOCUMENTS that RELATE to any COMMUNICATION, whether written or oral,  
3 between YOU and any potential class members.

4 **RESPONSE:**

5 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
6 objects to this request to the extent it asks Plaintiff to disclose work product or other  
7 privileged information. Plaintiff will not provide privileged information. Subject to these  
8 Objections, Plaintiff will produce any non-privileged, documents that can be located after  
9 a reasonable search that concern or constitute any communications concerning the  
10 subject matter of this lawsuit, made between Plaintiff and any other members of the  
11 proposed class.

12 **REQUEST NO. 24:**

13 All DOCUMENTS RELATED to any COMMUNICATIONS YOU have had with any  
14 PERSONS, including potential class members, that evidence, discuss, support, refer, or  
15 RELATE to any of the matters alleged in the COMPLAINT, including ANY written or  
16 recorded statements YOU have taken from anyone RELATING to any of the claims,  
17 defenses, contentions, allegations, or facts in this litigation.

18 **RESPONSE:**

19 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
20 objects to this request to the extent it asks Plaintiff to disclose work product or other  
21 privileged information. Plaintiff will not provide privileged information. Subject to these  
22 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
23 to this request that can be located after a reasonable search.

24 **REQUEST NO. 25:**

25 All DOCUMENTS that RELATE to the manner in which YOU became a party to this  
26 action, including but not limited to advertisements or news articles, solicitations, emails,  
27 notices, or correspondence to which YOU responded.

28 **RESPONSE:**

1 Plaintiff incorporates the General Objections recited above as if fully stated here.

2 Plaintiffs object to this request as seeking privileged information. Plaintiffs will not  
3 provide privileged information. Plaintiffs further object to this request as irrelevant.

4 Plaintiffs will not produce any documents or communications responsive to this request.

5 **REQUEST NO. 26:**

6 All DOCUMENTS that RELATE to any relationship YOU have with any attorney, staff  
7 member, and/or family of any attorney or staff member at Dovel & Luner, LLP,  
8 including but not limited to representation agreement(s) and fee arrangement(s).

9 **RESPONSE:**

10 Plaintiff incorporates the General Objections recited above as if fully stated here.

11 Plaintiffs object to this request as seeking privileged information. Plaintiffs will not  
12 provide privileged information. Plaintiffs further object to this request as irrelevant.

13 Plaintiffs will not produce any documents or communications responsive to this request.

14 **REQUEST NO. 27:**

15 All DOCUMENTS and COMMUNICATIONS RELATING to YOUR allegation in  
16 Paragraph 28 of YOUR COMPLAINT that YOU “ha[ve] no adequate remedy at law.”

17 **RESPONSE:**

18 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
19 objects to this request to the extent it asks Plaintiff to disclose work product or other  
20 privileged information. Plaintiff will not provide privileged information. Subject to these  
21 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
22 to this request that can be located after a reasonable search.

23 **REQUEST NO. 28:**

24 All DOCUMENTS and COMMUNICATIONS RELATING to YOUR allegation in  
25 Paragraph 33 of YOUR COMPLAINT that “[t]he proposed class contains members so  
26 numerous that separate joinder of each member of the class is impracticable.”

27 **RESPONSE:**

1 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
2 objects to this request to the extent it asks Plaintiff to disclose work product or other  
3 privileged information. Plaintiff will not provide privileged information. Subject to these  
4 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
5 to this request that can be located after a reasonable search.

6 **REQUEST NO. 29:**

7 All DOCUMENTS and COMMUNICATIONS RELATING to YOUR allegation in  
8 Paragraph 36 of YOUR COMPLAINT that YOUR “claims are typical of the proposed  
9 class.”

10 **RESPONSE:**

11 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
12 objects to this request to the extent it asks Plaintiff to disclose work product or other  
13 privileged information. Plaintiff will not provide privileged information. Subject to these  
14 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
15 to this request that can be located after a reasonable search.

16 **REQUEST NO. 30:**

17 All DOCUMENTS and COMMUNICATIONS RELATING to YOUR allegation in  
18 Paragraph 36 of YOUR COMPLAINT that “[t]here are no conflicts of interest between  
19 [YOU] and the class.”

20 **RESPONSE:**

21 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
22 objects to this request to the extent it asks Plaintiff to disclose work product or other  
23 privileged information. Plaintiff will not provide privileged information. Subject to these  
24 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
25 to this request that can be located after a reasonable search.

26 **REQUEST NO. 31:**

27 All DOCUMENTS and COMMUNICATIONS RELATING to YOUR allegation in  
28 Paragraph 37 of YOUR COMPLAINT that “[a] class action is superior to all other



1 available methods for the fair and efficient adjudication of this litigation because  
2 individual litigation is impractical.”

3 **RESPONSE:**

4 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
5 objects to this request to the extent it asks Plaintiff to disclose work product or other  
6 privileged information. Plaintiff will not provide privileged information. Subject to these  
7 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
8 to this request that can be located after a reasonable search.

9 **REQUEST NO. 32:**

10 All DOCUMENTS and COMMUNICATIONS RELATING to actual or potential  
11 conflicts of interest YOU may have with putative or purported class members that make  
12 up the alleged class as pled in YOUR COMPLAINT.

13 **RESPONSE:**

14 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
15 objects to this request to the extent it asks Plaintiff to disclose work product or other  
16 privileged information. Plaintiff will not provide privileged information. Subject to these  
17 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
18 to this request that can be located after a reasonable search.

19 **REQUEST NO. 33:**

20 All DOCUMENTS that RELATE to any representations, agreements, promises or  
21 assurances YOU received about any monetary recovery YOU might receive as a result of  
22 YOUR participation as a plaintiff in this lawsuit.

23 **RESPONSE:**

24 Plaintiff incorporates the General Objections recited above as if fully stated here.  
25 Plaintiffs interprets this request as seeking communications with counsel and, on that  
26 basis, objects to this request as seeking privileged information. Plaintiffs will not provide  
27 privileged information. Plaintiffs will not produce any documents or communications  
28 responsive to this request.

1 **REQUEST NO. 34:**

2 All DOCUMENTS that RELATE to any agreement YOU have with YOUR attorneys, or  
3 any other PERSON or entity, or any agreement YOUR attorneys have with any other  
4 PERSON or entity, concerning:

- 5 i. the payment or advancement of attorneys' fees, expenses, and costs with  
6 respect to this lawsuit;  
7 ii. who will advance, and who is responsible for, payment of the costs and  
8 expenses incurred in connection with the prosecution of this lawsuit; or  
9 iii. whether a fee in this lawsuit will be shared with any PERSON not a member  
10 of YOUR attorneys' law firms.

11 **RESPONSE:**

12 Plaintiff incorporates the General Objections recited above as if fully stated here.

13 Plaintiffs object to this request as seeking privileged information. Plaintiffs will not  
14 provide privileged information. Plaintiffs further object to this request as irrelevant.

15 Plaintiffs will not produce any documents or communications responsive to this request.

16 **REQUEST NO. 35:**

17 All DOCUMENTS and COMMUNICATIONS RELATING to YOUR allegation in  
18 Paragraph 19 of YOUR COMPLAINT that "[n]o reasonable consumer expects that a  
19 bottle labeled 'Avocado Oil,' featuring photos of avocados, and listing only 'avocado oil'  
20 as its ingredient contains other, cheaper, non-avocado oils."

21 **RESPONSE:**

22 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
23 objects to this request to the extent it asks Plaintiff to disclose work product or other  
24 privileged information. Plaintiff will not provide privileged information. Subject to these  
25 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
26 to this request that can be located after a reasonable search.

27 **REQUEST NO. 36:**

1 All DOCUMENTS and COMMUNICATIONS RELATING to YOUR allegation in  
2 Paragraph 20 of YOUR COMPLAINT that the PRODUCT(S) “contains high levels of  
3 other oils, including oleic sunflower or safflower oils.”

4 **RESPONSE:**

5 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
6 objects to this request to the extent it asks Plaintiff to disclose work product or other  
7 privileged information. Plaintiff will not provide privileged information. Subject to these  
8 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
9 to this request that can be located after a reasonable search.

10 **REQUEST NO. 37:**

11 All DOCUMENTS and COMMUNICATIONS RELATING to YOUR allegation in  
12 Paragraph 21 of YOUR COMPLAINT that “consumers choose to pay more for avocado  
13 oil products, because they believe that the products that they are receiving are  
14 unadulterated avocado oil, and not an oil that is adulterated with cheaper oils.”

15 **RESPONSE:**

16 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
17 objects to this request to the extent it asks Plaintiff to disclose work product or other  
18 privileged information. Plaintiff will not provide privileged information. Subject to these  
19 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
20 to this request that can be located after a reasonable search.

21 **REQUEST NO. 38:**

22 All DOCUMENTS and COMMUNICATIONS RELATING to YOUR allegation in  
23 Paragraph 22 of YOUR COMPLAINT that the “Defendant knows, or reasonably should  
24 know, that its labeling is misleading customers.”

25 **RESPONSE:**

26 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
27 objects to this request to the extent it asks Plaintiff to disclose work product or other  
28 privileged information. Plaintiff will not provide privileged information. Subject to these

1 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
2 to this request that can be located after a reasonable search.

3 **REQUEST NO. 39:**

4 All DOCUMENTS and COMMUNICATIONS RELATING to YOUR allegation in  
5 Paragraph 24 of YOUR COMPLAINT that “if Defendant accurately labeled its Product,  
6 consumers would not have purchased the Products or would have paid less for the  
7 Products.”

8 **RESPONSE:**

9 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
10 objects to this request to the extent it asks Plaintiff to disclose work product or other  
11 privileged information. Plaintiff will not provide privileged information. Subject to these  
12 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
13 to this request that can be located after a reasonable search.

14 **REQUEST NO. 40:**

15 All DOCUMENTS and COMMUNICATIONS RELATING to YOUR allegation in  
16 Paragraph 25 of YOUR COMPLAINT that YOU “paid for a superior product worth  
17 more, and received an inferior product that was inaccurately labeled.”

18 **RESPONSE:**

19 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
20 objects to this request to the extent it asks Plaintiff to disclose work product or other  
21 privileged information. Plaintiff will not provide privileged information. Subject to these  
22 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
23 to this request that can be located after a reasonable search.

24 **REQUEST NO. 41:**

25 All DOCUMENTS and COMMUNICATIONS RELATING to YOUR allegation in  
26 Paragraph 26 of YOUR COMPLAINT that YOU “would not have purchased the  
27 Product if [YOU] had known that the Product was contaminated with other oils, or  
28 [YOU] would have paid less for it.”

1 **RESPONSE:**

2 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
3 objects to this request to the extent it asks Plaintiff to disclose work product or other  
4 privileged information. Plaintiff will not provide privileged information. Subject to these  
5 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
6 to this request that can be located after a reasonable search.

7 **REQUEST NO. 42:**

8 All DOCUMENTS and COMMUNICATIONS RELATING to YOUR allegation in  
9 Paragraph 26 of YOUR COMPLAINT that “[t]he package prominently stated ‘Avocado  
10 Oil’ and had pictures of avocados, “[t]he ingredient list also listed only avocado oil,” and  
11 that YOU “read and relied on these statements when purchasing the Product.”

12 **RESPONSE:**

13 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
14 objects to this request to the extent it asks Plaintiff to disclose work product or other  
15 privileged information. Plaintiff will not provide privileged information. Subject to these  
16 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
17 to this request that can be located after a reasonable search.

18 **REQUEST NO. 43:**

19 All DOCUMENTS and COMMUNICATIONS RELATING to YOUR allegation in  
20 Paragraph 27 of YOUR COMPLAINT that “[i]f Walmart fixes their Products, so that the  
21 avocado oil is actually unadulterated and not contaminated with other oils, [YOU] would  
22 buy them again.”

23 **RESPONSE:**

24 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
25 objects to this request to the extent it asks Plaintiff to disclose work product or other  
26 privileged information. Plaintiff will not provide privileged information. Subject to these  
27 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
28 to this request that can be located after a reasonable search.



1 **REQUEST NO. 44:**

2 All DOCUMENTS and COMMUNICATIONS RELATING to YOUR contention that  
3 the PRODUCT is adulterated, impure, or not avocado oil, including but not limited to all  
4 DOCUMENTS and COMMUNICATIONS YOU contend show or suggest the  
5 PRODUCT is adulterated, impure, or not avocado oil.

6 **RESPONSE:**

7 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
8 objects to this request to the extent it asks Plaintiff to disclose work product or other  
9 privileged information. Plaintiff will not provide privileged information. Subject to these  
10 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
11 to this request that can be located after a reasonable search.

12 **REQUEST NO. 45:**

13 All DOCUMENTS and COMMUNICATIONS regarding YOUR purchase of any  
14 avocado oil, aside from the PRODUCT, from September 24, 2020 to the present.

15 **RESPONSE:**

16 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
17 objects to this request to the extent it asks Plaintiff to disclose work product or other  
18 privileged information. Plaintiff will not provide privileged information. Subject to these  
19 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
20 to this request that can be located after a reasonable search.

21 **REQUEST NO. 46:**

22 All DOCUMENTS and COMMUNICATIONS REGARDING when YOU became  
23 aware that the PRODUCT(S) were adulterated, impure, or not entirely avocado oil.

24 **RESPONSE:**

25 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
26 objects to this request to the extent it asks Plaintiff to disclose work product or other  
27 privileged information. Plaintiff will not provide privileged information. Subject to these  
28

1 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
2 to this request that can be located after a reasonable search.

3 **REQUEST NO. 47:**

4 All DOCUMENTS and COMMUNICATIONS REGARDING when YOU became  
5 aware that avocado oil sold in retail stores might be adulterated, impure, or not entirely  
6 avocado oil.

7 **RESPONSE:**

8 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
9 objects to this request to the extent it asks Plaintiff to disclose work product or other  
10 privileged information. Plaintiff will not provide privileged information. Subject to these  
11 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
12 to this request that can be located after a reasonable search.

13 **REQUEST NO. 48:**

14 All DOCUMENTS and COMMUNICATIONS RELATING to any economic or other  
15 injury YOU claim to have sustained as a result of any of WALMART's acts,  
16 representations, or omissions alleged in the COMPLAINT.

17 **RESPONSE:**

18 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
19 objects to this request to the extent it asks Plaintiff to disclose work product or other  
20 privileged information. Plaintiff will not provide privileged information. Subject to these  
21 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
22 to this request that can be located after a reasonable search.

23 **REQUEST NO. 49:**

24 All DOCUMENTS and COMMUNICATIONS RELATING to any economic or other  
25 injury YOU claim to have sustained as a result of any VENDOR's acts, representations,  
26 or omissions alleged in the COMPLAINT.

27 **RESPONSE:**

1 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
2 objects to this request to the extent it asks Plaintiff to disclose work product or other  
3 privileged information. Plaintiff will not provide privileged information. Subject to these  
4 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
5 to this request that can be located after a reasonable search.

6 **REQUEST NO. 50:**

7 All DOCUMENTS on which YOU intend to rely in support of YOUR claims or alleged  
8 damages in YOUR COMPLAINT.

9 **RESPONSE:**

10 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
11 objects to this request to the extent it asks Plaintiff to disclose work product or other  
12 privileged information. Plaintiff will not provide privileged information. Subject to these  
13 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
14 to this request that can be located after a reasonable search.

15 **REQUEST NO. 51:**

16 All curriculum vitae or resumes of any expert who may offer evidence in support of class  
17 certification, at trial or with respect to any other motion in this lawsuit that is the subject  
18 of YOUR COMPLAINT and copies of all publications, reports, presentations or other  
19 documents referred to on the curriculum vitae or resume of each such expert.

20 **RESPONSE:**

21 Plaintiff incorporates the General Objections recited above as if fully stated here.  
22 Plaintiff objects to this request as premature, as it relates to expert discovery, and the  
23 period for expert discovery has not yet commenced. Plaintiff further objects to this  
24 request as overbroad and unduly burdensome insofar as it seeks production of expert  
25 materials well beyond the scope of expert discovery set forth in Rule 26. Plaintiff agrees  
26 to confer with Defendant on the scope of mutually agreeable expert discovery for both  
27 parties' experts.

28 **REQUEST NO. 52:**

1 All DOCUMENTS that RELATE to any compensation or consideration to be given to  
2 any expert who may offer evidence in support of class certification, at trial or with respect  
3 to any other motion in this lawsuit, including but not limited to retention agreements,  
4 invoices, and proof of payment.

5 **RESPONSE:**

6 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
7 objects to this request to the extent it asks Plaintiff to disclose work product or other  
8 privileged information. Plaintiff will not provide privileged information. Plaintiff objects  
9 to this request as premature, as it relates to expert discovery, and the period for expert  
10 discovery has not yet commenced. Plaintiff further objects to this request as overbroad  
11 and unduly burdensome insofar as it seeks production of expert materials well beyond  
12 the scope of expert discovery set forth in Rule 26. Plaintiff agrees to confer with  
13 Defendant on the scope of mutually agreeable expert discovery for both parties' experts.

14 **REQUEST NO. 53:**

15 All expert reports and transcripts of depositions, hearings, and trial testimony given or  
16 written within the preceding four years, in any matter, by any expert who may offer  
17 evidence in support of class certification, at trial or with respect to any other motion in  
18 this lawsuit.

19 **RESPONSE:**

20 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
21 objects to this request as premature, as it relates to expert discovery, and the period for  
22 expert discovery has not yet commenced. Plaintiff further objects to this request as  
23 overbroad and unduly burdensome insofar as it seeks production of expert materials well  
24 beyond the scope of expert discovery set forth in Rule 26. Plaintiff agrees to confer with  
25 Defendant on the scope of mutually agreeable expert discovery for both parties' experts.

26 **REQUEST NO. 54:**

27 All DOCUMENTS currently in YOUR possession that YOU intend to introduce at the  
28 deposition of any representative, agent, officer, employee of WALMART.

1 **RESPONSE:**

2 Plaintiff incorporates the General Objections recited above as if fully stated here. Subject  
3 to these Objections, Plaintiff will produce any non-privileged, documents reasonably  
4 responsive to this request that can be located after a reasonable search.

5 **REQUEST NO. 55:**

6 All non-privileged DOCUMENTS that RELATE to each occasion YOU have  
7 participated as a class representative in any other lawsuit.

8 **RESPONSE:**

9 Plaintiff incorporates the General Objections recited above as if fully stated here.  
10 Plaintiff objects to this request as irrelevant and overbroad insofar as it seeks “all ...  
11 DOCUMENTS that RELATE.” Plaintiff agrees to confer with Defendant to discuss the  
12 purported relevance of the requested documents to see if agreement can be reached on  
13 the appropriate scope of this request.

14 **REQUEST NO. 56:**

15 All DOCUMENTS that RELATE to any legal proceedings commenced at any time in  
16 any court or with any arbitration organization in which YOU have sought to be a class  
17 representative in a class action, in which YOU brought suit derivatively on behalf of a  
18 corporation, or in which YOU represented or assisted in the representation of any  
19 plaintiffs, defendants, or other PERSONS in a legal proceeding brought as a class,  
20 derivative or private attorney general action.

21 **RESPONSE:**

22 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
23 objects to this request to the extent it asks Plaintiff to disclose work product or other  
24 privileged information. Plaintiff will not provide privileged information. Plaintiff objects  
25 to this request as irrelevant and overbroad insofar as it seeks “all ... Documents that  
26 RELATE.” Plaintiff agrees to confer with Defendant to discuss the purported relevance  
27 of the requested documents to see if agreement can be reached on the appropriate scope  
28 of this request.



1 **REQUEST NO. 57:**

2 All DOCUMENTS evidencing, referring or RELATING to any other actions, lawsuits,  
3 arbitrations, bankruptcies, insolvency proceedings or other adjudicatory proceedings or  
4 regulatory enforcement actions or investigations to which YOU are or have been a party  
5 during the past ten years.

6 **RESPONSE:**

7 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
8 objects to this request to the extent it asks Plaintiff to disclose work product or other  
9 privileged information. Plaintiff will not provide privileged information. Plaintiff objects  
10 to this request as irrelevant and overbroad insofar as it seeks “all ... Documents.”  
11 Plaintiff agrees to confer with Defendant to discuss the purported relevance of the  
12 requested documents to see if agreement can be reached on the appropriate scope of this  
13 request.

14 **REQUEST NO. 58:**

15 All DOCUMENTS and COMMUNICATIONS evidencing or supporting YOUR  
16 testimony that YOU “purchased bottles of Great Value Avocado Oil from a Walmart  
17 store while living in Tarzana, California” and “paid approximately \$8.23 for each bottle,”  
18 as stated in Paragraph 2 of YOUR December 27, 2024 Declaration filed in support of  
19 YOUR Motion for Class Certification (ECF 36-1).

20 **RESPONSE:**

21 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
22 objects to this request to the extent it asks Plaintiff to disclose work product or other  
23 privileged information. Plaintiff will not provide privileged information. Subject to these  
24 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
25 to this request that can be located after a reasonable search.

26 **REQUEST NO. 59:**

27 All DOCUMENTS and COMMUNICATIONS evidencing or supporting YOUR  
28 testimony that YOU “believed that Great Value Avocado Oil contained unadulterated

1 avocado oil” as stated in Paragraph 3 of YOUR December 27, 2024 Declaration filed in  
2 support of YOUR Motion for Class Certification (ECF 36-1).

3 **RESPONSE:**

4 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
5 objects to this request to the extent it asks Plaintiff to disclose work product or other  
6 privileged information. Plaintiff will not provide privileged information. Subject to these  
7 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
8 to this request that can be located after a reasonable search.

9 **REQUEST NO. 60:**

10 All DOCUMENTS and COMMUNICATIONS evidencing or supporting YOUR  
11 testimony that YOU “do not know of or foresee any conflicts of interest between  
12 [yourself] and any other class members,” as stated in Paragraph 5 of YOUR December  
13 27, 2024 Declaration filed in support of YOUR Motion for Class Certification (ECF 36-  
14 1).

15 **RESPONSE:**

16 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
17 objects to this request to the extent it asks Plaintiff to disclose work product or other  
18 privileged information. Plaintiff will not provide privileged information. Subject to these  
19 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
20 to this request that can be located after a reasonable search.

21 **REQUEST NO. 61:**

22 All DOCUMENTS and COMMUNICATIONS evidencing or supporting YOUR  
23 testimony that “Had [YOU] known that the products were adulterated, [YOU] would not  
24 have purchased them or would have paid the price [YOU] paid for them,” as stated in  
25 Paragraph 4 of YOUR December 27, 2024 Declaration filed in support of YOUR Motion  
26 for Class Certification (ECF 36-1).

27 **RESPONSE:**

1 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
2 objects to this request to the extent it asks Plaintiff to disclose work product or other  
3 privileged information. Plaintiff will not provide privileged information. Subject to these  
4 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
5 to this request that can be located after a reasonable search.

6 **REQUEST NO. 62:**

7 All DOCUMENTS and COMMUNICATIONS evidencing or supporting YOUR  
8 testimony that YOU “have actively participated in this case,” as stated in Paragraph 6 of  
9 YOUR December 27, 2024 Declaration filed in support of YOUR Motion for Class  
10 Certification (ECF 36-1).

11 **RESPONSE:**

12 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
13 objects to this request to the extent it asks Plaintiff to disclose work product or other  
14 privileged information. Plaintiff will not provide privileged information. Subject to these  
15 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
16 to this request that can be located after a reasonable search.

17 **REQUEST NO. 63:**

18 All DOCUMENTS and COMMUNICATIONS REGARDING the  
19 “additional testing” performed by Ceutical Labs “on a sample of Great Value Avocado  
20 Oil,” as described in Paragraph 15 of the Declaration of Richard Lyon dated January 8,  
21 2025 (ECF No. 36-3) and as described in the Declaration of Imel Courtland (ECF No.  
22 41-1), including but not limited to the testing results attached as Exhibit 11 to the  
23 Declaration.

24 **RESPONSE:**

25 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
26 objects to this request to the extent it asks Plaintiff to disclose work product or other  
27 privileged information. Plaintiff will not provide privileged information. Subject to these  
28

1 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
2 to this request that can be located after a reasonable search.

3 **REQUEST NO. 64:**

4 The bottle(s) of PRODUCT, including any “sample,” tested by Ceutical Labs as described  
5 in Paragraph 15 of the Declaration of Richard Lyon dated January 8, 2025 (ECF No. 36-  
6 3).

7 **RESPONSE:**

8 Plaintiff incorporates the General Objections recited above as if fully stated here. Subject  
9 to these Objections, Plaintiff will produce photographs of the bottles and packaging and  
10 confer with Defendant about inspection.

11 **REQUEST NO. 65:**

12 All DOCUMENTS and COMMUNICATIONS supporting or evidencing the “prices” of  
13 “Walmart’s cooking oil products from the Walmart website,” as described in Paragraph 2  
14 of the Declaration of Richard Lyon dated January 8, 2025 (ECF No. 36-3).

15 **RESPONSE:**

16 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
17 objects to this request to the extent it asks Plaintiff to disclose work product or other  
18 privileged information. Plaintiff will not provide privileged information. Subject to these  
19 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
20 to this request that can be located after a reasonable search.

21 **REQUEST NO. 66:**

22 All DOCUMENTS and COMMUNICATIONS supporting or evidencing the contention  
23 that testing “results indicate that the tested oil is adulterated with some other oil that is  
24 not avocado oil” and “reveal that the indicat[e] that the sample was adulterated with oils  
25 other than avocado oil” in Paragraphs 4 and 7 of the Declaration of Imel Courtland (ECF  
26 No. 41-1).

27 **RESPONSE:**

1 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
2 objects to this request to the extent it asks Plaintiff to disclose work product or other  
3 privileged information. Plaintiff will not provide privileged information. Subject to these  
4 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
5 to this request that can be located after a reasonable search.

6 **REQUEST NO. 67:**

7 All DOCUMENTS and COMMUNICATIONS supporting or evidencing the contention  
8 that testing “the sample” of the PRODUCT “is adulterated with oils other than avocado  
9 oil” in Paragraph 6 of the Declaration of Imel Courtland (ECF No. 41-1).

10 **RESPONSE:**

11 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
12 objects to this request to the extent it asks Plaintiff to disclose work product or other  
13 privileged information. Plaintiff will not provide privileged information. Subject to these  
14 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
15 to this request that can be located after a reasonable search.

16 **REQUEST NO. 68:**

17 All DOCUMENTS and COMMUNICATIONS REGARDING any testing performed  
18 on the PRODUCTS, including but not limited to any testing by Ceutical Laboratories,  
19 Inc. or any other laboratory or facility.

20 **RESPONSE:**

21 Plaintiff incorporates the General Objections recited above as if fully stated here. Plaintiff  
22 objects to this request to the extent it asks Plaintiff to disclose work product or other  
23 privileged information. Plaintiff will not provide privileged information. Subject to these  
24 Objections, Plaintiff will produce any non-privileged, documents reasonably responsive  
25 to this request that can be located after a reasonable search.



1 Dated: March 10, 2025

Respectfully submitted,

2 By: /s/ Richard Lyon

3 Richard Lyon (Cal Bar No. 229288)  
rick@dovel.com

4 Christin Cho (Cal. Bar No. 238173)  
5 christin@dovel.com

6 DOVEL & LUNER, LLP  
201 Santa Monica Blvd., Suite 600

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8 Telephone: (310) 656-7066

9 Facsimile: (310) 656-7069

10 *Attorney for Plaintiff*

**CERTIFICATE OF SERVICE**

I hereby certify that on March 10, 2025, the foregoing document is being served by  
e-mail on counsel of record.

/s/ Richard Lyon  
Richard Lyon

# EXHIBIT I



Suite 2700  
350 South Grand Avenue  
Los Angeles, CA 90071

**Jacob M. Harper**  
213.633.6863 tel  
213.633.6899 fax

jacobharper@dwt.com

March 31, 2025

Richard Lyon  
Christin Cho  
Dovel & Luner, LLP  
201 Santa Monica Blvd., Suite 600  
Santa Monica, CA 90401  
rick@dovel.com  
christin@dovel.com

**Re: *Golikov v. Walmart Inc.*, No. 2:24-cv-08211-RGK-MAR (C.D. Cal.) – Meet and Confer on Plaintiff’s Responses to Walmart’s Requests for Production, Set One**

Dear Counsel:

We write on behalf of defendant Walmart Inc. to meet and confer regarding deficiencies with plaintiff Edie Golikov’s responses to Walmart’s First Set of Requests for Production, served on March 10, 2025. The issues identified below are not exhaustive, but rather provide a jumping off point for discussion in hopes of finding agreement where possible and narrowing issues for court-sanctioned resolution. Please provide amended responses by Friday, April 4, or let us know when you are available to meet and confer by that date.

#### **A. General Objections**

Plaintiff states a number of general objections. Walmart takes no issue with truly “general” objections based on the assertion of privilege or confidentiality. As to confidentiality, however, Walmart expects the parties to enter into a protective order governing the production of documents and information in this action and requests that Plaintiff confirm she will produce documents subject to that protective order.

The remaining general objections (e.g., beyond scope of permitted discovery, overbroad, unduly burdensome, vague, ambiguous, posed for improper purpose, irrelevant, etc.) are facially improper and cannot reasonably be said to apply to all of Walmart’s discovery requests. *See* Fed. R. Civ. P. 34(b)(2)(B) (“*For each item or category*, the response must either state that inspection and related activities will be permitted as requested *or state with specificity the grounds for objecting to the request*, including the reasons.”) (emphases added); *see also Bragel Int’l, Inc. v. Kohl’s Dept. Stores*, 2018 WL 7890682, at \*5 (C.D. Cal. 2018) (noting that “[i]t is the longstanding practice in federal court that boilerplate objections and unsupported privilege assertions ... are improper” and that “objections based on proportionality be explained with

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specificity.”). Please provide written confirmation that Plaintiff is not withholding any documents subject to these improper “general” objections.

Plaintiff also generally objected to the extent the requests “seek the disclosure of information existing in the public domain.” However, Walmart is entitled to know what documents Plaintiff has in her possession, custody, or control supporting her contentions, even if those documents may be publicly available somewhere. Please provide written confirmation that Plaintiff will produce responsive documents she has agreed to produce that are in her possession, custody, or control notwithstanding that those documents are also otherwise publicly available.

### **B. Objections to “RELATE,” “RELATED,” and “RELATING”**

Plaintiff objects to the definitions of “RELATE,” “RELATED,” and “RELATING” on the grounds that they are overly broad, incorporate information that is not relevant to this lawsuit, and are not reasonably calculated to lead to the discovery of admissible evidence. These objections are facially improper and cannot reasonably be said to apply to all of Walmart’s discovery requests. *See* Fed. R. Civ. P. 34(b)(2)(B) (“*For each item or category, the response must either state that inspection and related activities will be permitted as requested or state with specificity the grounds for objecting to the request, including the reasons.*”) (emphases added); *see also* *Bragel*, 2018 WL 7890682, at \*5. Please provide written confirmation that Plaintiff is not withholding any documents subject to these improper objections or, alternatively, amend your responses to identify which requests Plaintiff objects to on these grounds.

### **C. Agreed Upon Requests**

Plaintiff stated that she “will produce any non-privileged, documents reasonably responsive to this request that can be located after a reasonable search” to the following requests: RFP Nos. 2-9 (product purchases and vendor interactions); 11 (photos of purchased products); 13-17 (communications with Walmart, governmental agencies, putative class members, and third-parties); 20-22 (communications with putative class members and on social media regarding avocado oil or Walmart); 24 (communications with putative class members relating to claims); 27-32 (class action allegations and conflicts); 35-50 (avocado oil allegations and alleged injury); 54 (deposition documents); 58-63 (alleged purchases and reliance, class representation, and testing allegations); 65-68 (pricing and testing allegations).

*First*, Plaintiff may not narrow the documents it produces to those it unilaterally deems “*reasonably* responsive.” Walmart will construe this response, and variations thereof, as agreeing to conduct a reasonable search for documents responsive to those requests and produce any responsive (and non-privileged) documents from that search, not just those Plaintiff unilaterally deems “reasonably” responsive. Please provide written confirmation that Plaintiff



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agrees with this understanding or, if not, please state your position in writing and be prepared to discuss that position during the requested meet and confer.

*Second*, please let us know when Plaintiff expects to begin and end her search for, and production of, documents in response to these requests (and in accordance with the preceding paragraph). Plaintiff also objected to these requests “to the extent [they] ask[] Plaintiff to disclose work product or other privileged information.” To the extent Plaintiff redacts or withholds any documents responsive to these requests on the basis of any such privilege, please promptly provide a privilege log justifying those assertions. *See* Fed. R. Civ. P. 26(b); *see also Burlington N. & Santa Fe Ry. Co. v. U.S. Dist. Court for Dist. of Mont.*, 408 F.3d 1142, 1148 (9th Cir. 2005) (party claiming privilege must “provide sufficient information to enable other parties to evaluate the applicability of the claimed privilege or protection”). Please also provide written confirmation that no documents will be redacted or withheld as to any of these requests based on any objections besides privilege.

#### **D. Narrowed Requests**

Plaintiff stated that she would search for and produce documents or information in response to the following requests, but narrowed the scope of those requests: RFP Nos. 1 (transactions with Walmart); 10 (physical bottle and packaging); 12 (refund requests); 18 (communications with other potential plaintiffs); 19 (communications with putative class members); 23 (same); 64 (bottle of alleged test sample).

*First*, the issues raised above under “Agreed Upon Requests” with respect to those requests also apply to these requests.

*Second*, Plaintiff did not state any basis for narrowing the scope of these requests other than objecting to the extent these requests seek privileged information. Plaintiff accordingly waived any other objections to these requests. *See Richmark Corp. v. Timber Falling Consultants*, 959 F.2d 1468, 1473 (9th Cir. 1992) (“It is well established that a failure to object to discovery requests within the time required constitutes a waiver of any objection.”).

*Third*, to the extent Plaintiff redacts or withholds any documents as to these requests on privilege grounds, Plaintiff must provide a privilege log justifying those assertions. *See* Fed. R. Civ. P. 26(b); *see also Burlington N.*, 408 F.3d at 1148 (party claiming privilege must “provide sufficient information to enable other parties to evaluate the applicability of the claimed privilege or protection”). She failed to do so.

*Fourth*, Walmart objects to Plaintiff’s attempts to narrow the scope of these requests. Documents responsive to these requests are not invariably privileged and Plaintiff waived any other basis for narrowing the scope of these requests. Plaintiff seeks to limit RFP Nos. 1

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(transactions with Walmart) and 12 (refund requests) to documents concerning avocado oil products, but asserts no basis for such a limitation. No such limitation is warranted. Plaintiff's purchases of other products from Walmart are relevant because they bear on Plaintiff's motivation for bringing this action, as well as what Plaintiff considers material and relies upon in making her purchases. *See, e.g., Harris v. Vector Marketing Corp.*, 753 F. Supp. 2d 996, 1015 (N.D. Cal. Nov. 5, 2010) (“[t]he honesty and credibility of a class representative is a relevant consideration when performing the adequacy inquiry ‘because an untrustworthy plaintiff could reduce the likelihood of prevailing on the class claims.’”). For example, if Plaintiff only purchased the alleged avocado oil bottle, then a fact finder could find that Plaintiff purchased it solely for purposes of litigation and question whether Plaintiff was in fact misled by the label. For similar reasons, other refunds Plaintiff has (or has not) sought from Walmart are relevant to whether Plaintiff was actually misled.

Plaintiff also seeks to limit RFP Nos. 10 (physical bottle and packaging) and 64 (bottle of alleged test sample) to photographs of the avocado oil bottle she allegedly purchased and tested (but asserts no basis for such a limitation). No such limitation is warranted. The physical bottle itself is relevant given the key dispute here of whether the batch of avocado oil she purchased contained non-avocado oil ingredients, and pictures are not enough to challenge the credibility of those assertions. *See Fed. R. Civ. P. 34(a)(1)(B)* (permitting requesting party “to inspect, copy, test, or sample...any designated tangible things” in responding party’s possession, custody, or control); *cf. Ang v. Bimbo Bakeries USA, Inc.*, 2014 WL 1024182 (N.D. Cal. March 13, 2014) (“where the actual composition or appearance of the product is legally significant to the claim at issue, the consumer may only be allowed to pursue claims for products with identical product composition and/or appearance.”).

Plaintiff also seeks to limit RFP Nos. 18 (communications with other potential plaintiffs), 19 (communications with putative class members) and 23 (same) to communications made between Plaintiff and any other potential plaintiff in this action or members of the proposed class (but asserts no basis for such a limitation). This unjustifiably excludes communications including Plaintiff’s counsel, which are relevant to class certification issues. *See, e.g., Depina v. FedEx Ground Package System, Inc.*, 730 F. Supp. 3d 954 (N.D. Cal. Apr. 16, 2024) (permitting discovery of plaintiff counsel’s surveys to, and communications with, putative class members).

Please amend your responses to state that Plaintiff will not narrow the scope of these requests, or let us know your availability for a call to discuss further.

#### **E. Refused Requests**

Plaintiff stated that she will not produce any documents or communications responsive to the following requests: RFP Nos. 25-26 (recruitment by and relationship with counsel); 33 (compensation as class representative); 34 (litigation funding).

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As to RFP Nos. 25-26 (recruitment by and relationship with counsel) and 34 (litigation funding), Plaintiff objects to producing any documents on the grounds that they are irrelevant. However, these requests are relevant because they bear on class certification issues like Plaintiff's and counsel's motivations for bringing this action and Plaintiff's ability to fairly and adequately serve as a class representative. *See, e.g., Rodriguez v. West Pub. Corp.*, 563 F.3d 948, 958–59 (9th Cir. 2009) (Plaintiffs' incentive agreement and retainer agreement with counsel is "plainly relevant" for issue of class certification, because it may disclose conflict of interest).

As to all of these requests, Plaintiff also objects on the grounds that they seek privileged information. But documents responsive to these requests are not invariably privileged. *See Gusman v. Comcast Corp.*, 298 F.R.D. 592, 600 (S.D. Cal. 2014) ("The Ninth Circuit has repeatedly held retainer agreements are not protected by the attorney-client privilege or work product doctrine.... Moreover, the attorney-client privilege generally does not preclude disclosure of fee agreements.") (collecting cases). In any event, Plaintiff must provide a privilege log justifying any assertions of privilege. *See* Fed. R. Civ. P. 26(b); *see also Burlington N.*, 408 F.3d at 1148 (a party claiming privilege must "provide sufficient information to enable other parties to evaluate the applicability of the claimed privilege or protection") (quotations omitted).

Please amend your responses to state that Plaintiff will search for and produce documents responsive to RFP Nos. 25-26, 33 and 34 and provide a privilege log justifying any redactions or documents withheld on the basis of any privilege, or let us know your availability for a call to discuss further.

#### **F. Requests to Meet and Confer**

Walmart accepts Plaintiff's offer to meet and confer to discuss a mutually agreeable scope for the following requests: RFP Nos. 51-53 (expert curriculum vitae, compensation or consideration and previous reports and deposition transcripts); 55-57 (class representative experience and other legal proceedings). Please let us know your availability to discuss further.

As to Plaintiff's objection that RFP Nos. 51-53 (expert curriculum vitae, compensation or consideration and previous reports and deposition transcripts) are premature, while discovery requests may not seek certain information prior to the exchange of expert witnesses, these requests do not implicate "'scientific, technical or other specialized' information" that "only an expert would be qualified to address." *Gorrell v. Sneath*, 292 F.R.D. 629, 633 (E.D. Cal. 2013). Please amend your responses to state that Plaintiff will not withhold documents as to these requests on the basis of this objection.

As to Plaintiff's objection to the extent these requests seek privileged information, Plaintiff must provide a privilege log justifying those assertions. *See* Fed. R. Civ. P. 26(b); *see*

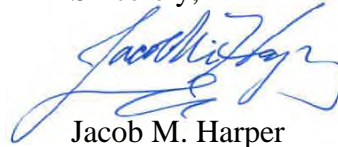
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March 31, 2025  
Page 6

*also Burlington N.*, 408 F.3d at 1148 (a party claiming privilege must “provide sufficient information to enable other parties to evaluate the applicability of the claimed privilege or protection”) (quotations omitted).

\* \* \*

Please let us know your position on these issues in writing, as discussed, and your availability to further discuss these issues. All of Walmart’s rights and remedies are expressly reserved.

Sincerely,



Jacob M. Harper  
Davis Wright Tremaine LLP

cc: Heather F. Canner  
Joseph Elie-Meyers

# **EXHIBIT J**

Abbreviation	Description	Date of Deposition	Declaration Exhibit Number
Bennett	Deposition of Jennifer Bennett, Plaintiff	1/18/2021	UUU
Bloomstein 30(b)(6)	Deposition of Quest by corporate representative Laura Bloomstein, Director of Revenue Recognition and Analytics	5/13/2021	J
Catti	Deposition of Lawrence Catti, Plaintiff	1/29/2021	VVV
Dannelly	Deposition of Diana Dannelly, Plaintiff	11/17/2020	NN
Freeman	Deposition of Clyde Freeman, Plaintiff	10/12/2020	QQ
Funari	Deposition of Valerie Funari, Plaintiff	12/8/2020	WWW
Golikov	Deposition of Edie Golikov, Plaintiff	2/12/2021	X
Gong	Deposition of Ling Gong, Plaintiff (Xin Tan's Husband)	12/23/2020	YYYY
Halpern	Deposition of Marc Halpern, Senior Director of Pricing Strategy	11/10/2020	H
Halpern 30(b)(6)	Deposition of Quest by corporate representative Marc Halpern, Senior Director of Pricing Strategy	3/11/2021	L
Hodges	Deposition of Lonnie Hodges, Jr., Plaintiff	10/26/2020	PP
Lake	Deposition of Pablo Lake, Leader of Revenue Services Dept. at Quest; Senior Vice President, Revenue Cycle Management at Optum360	9/9/2021	K
Koehler	Deposition of Quest by corporate representative Deborah Koehler, Senior Director of Compliance		FF
M. Leslie	Deposition of Marvin Leslie, Plaintiff	5/27/2021	ZZZ
V. Leslie	Deposition of Vicki Leslie, Plaintiff	7/1/2021	AAAA
Martyn	Deposition of Lily Martyn, Plaintiff	11/6/2020	BBBB
McCabe	Deposition of Quest by corporate representative Gary McCabe	2/11/2021 & 5/19/2021	C
Morabito	Deposition of Quest by corporate representative Jose Morabito, Vice President of Strategic Pricing	3/15/2021	I
A. Pojawis	Deposition of Anna Pojawis, Quest Patient	11/9/2020	CCCC
R. Pojawis	Deposition of Ryszard Pojawis, Plaintiff	12/18/2020	DDDD
T. Pojawis	Deposition of Teresa Pojawis, Family Member of Patient	5/24/2021	EEEE



Pruitt	Deposition of Quest by corporate representative Priscilla Pruitt, National Patient Services Director	4/1/2021	D
Roach	Deposition of Jill Roach, Plaintiff	10/21/2021	MM
Scott	Deposition of Carolyn Scott, Plaintiff	'12/2020 & 12/1/2020	DDD
Tan	Deposition of Xin Tan, Quest Patient	7/20/2021	GGGG
Timm	Deposition of Stephen Timm, Plaintiff	10/15/2020	F
Weston	Deposition of Quest by corporate representative Scott Weston	2/26/2021	N

# **EXHIBIT K**

**UNITED STATES DISTRICT COURT**  
**CENTRAL DISTRICT OF CALIFORNIA**  
**WESTERN DIVISION**

EDIE GOLIKOV, individually and on  
behalf of all others similarly situated,

Plaintiff,

v.

WALMART INC.,

Defendant.

Case No. 24-cv-08211-RGK-MAR

**DECLARATION OF PLAINTIFF  
EDIE GOLIKOV IN SUPPORT OF  
PLAINTIFF'S MOTION FOR  
CLASS CERTIFICATION**

Compl. filed: September 24, 2024

Assigned to the Hon. R. Gary Klausner  
Dept.: Courtroom 850

**DECLARATION OF EDIE GOLIKOV**

I, Edie Golikov, declare and state as follows:

1. I am the named Plaintiff in this action. I live in Los Angeles County, California. I make this declaration from my own personal knowledge and could competently testify to the following facts.

2. I purchased bottles of Great Value Avocado Oil from a Walmart store while living in Tarzana, California. I paid approximately \$8.23 for each bottle.

3. The labels of the Great Value Avocado Oil stated that the product was “Avocado Oil,” contained pictures of avocados, and listed “Avocado Oil” as the sole ingredient. I read and relied on these statements when purchasing Great Value Avocado Oil. I believed that Great Value Avocado Oil contained unadulterated avocado oil.

4. Had I known that the products were adulterated, I would not have purchased them or would not have paid the price I paid for them.

5. I am willing to serve as a class representative in this case. I understand that, as a class representative, my duty is to represent other California consumers who, like me, purchased misleadingly labeled Great Value Avocado Oil. I do not know of or foresee any conflicts of interest between myself and any other class members.

6. I have actively participated in this case and will continue to do so. I have discussed this case with my lawyers to stay updated, and I have reviewed the Complaint and Amended Complaint before they were filed.

7. I want Walmart to fix its practices and sell avocado oil with accurate labeling. Because of Walmart’s past failure to do so, however, I cannot rely on Walmart’s word alone that it has fixed the problem, and I will thus not be able to purchase Great Value Avocado Oil. But if the Court issued an order forbidding Walmart from claiming that Great Value Avocado Oil contains only avocado oil unless it actually contains unadulterated avocado oil, then I could trust Walmart’s

1 representations. With the security of such a Court order, I would consider buying  
2 Great Value Avocado Oil again.

3  
4 I declare under penalty of perjury that the foregoing is true and correct.

5  
6 Dated: 12/27/2024

By:   
4599E24D18334C2...  
Edie Golikov

# **EXHIBIT L**



Richard Lyon (Cal. Bar No. 229288)  
rick@dovel.com  
Stephen D. Andrews (Cal. Bar No. 335335)  
stephen@dovel.com  
DOVEL & LUNER, LLP  
201 Santa Monica Blvd., Suite 600  
Santa Monica, California 90401  
Telephone: (310) 656-7066  
Facsimile: (310) 656-7069

*Attorney for Plaintiffs*

**UNITED STATES DISTRICT COURT  
CENTRAL DISTRICT OF CALIFORNIA**

EDIE GOLIKOV, individually and  
on behalf of all others similarly  
situated,

*Plaintiff,*

v.

WALMART INC.,

*Defendant.*

Case No. 2:24-cv-08211-RGK-MAR

**DECLARATION OF RICHARD  
LYON IN SUPPORT OF  
PLAINTIFF'S MOTION FOR CLASS  
CERTIFICATION**

Date: February 10, 2025

Time: 9:00 a.m.

Dept.: Courtroom 850

Assigned to the Hon. R. Gary Klausner

Complaint filed: September 24, 2024

**DECLARATION OF RICK LYON**

I, Richard Lyon, declare and state as follows:

1. I am a member in good standing of the bar of the state of California and a partner in the law firm of Dovel Luner LLP. I represent Plaintiff Edie Golikov in the above-referenced matter and am lead counsel for Ms. Golikov in this matter.

2. The following are true and accurate copies of listings for Walmart's cooking oil products from the Walmart website (www.walmart.com), accessed December 18, 2024:

Exhibit	Description	Price	Price Per Oz
1	Great Value Avocado Oil – 25.5 fl. oz	\$9.72	\$.381/oz
2	Great Value Vegetable Oil – 48 fl. oz	\$4.37	\$.091/oz

3. Attached as **Exhibit 3** is a true and correct copy of a scientific article published in the journal Food Control titled *Purity and quality of private labelled avocado oil*, accessible at <https://www.sciencedirect.com/science/article/pii/S0956713523002372>.

4. Attached as **Exhibit 4** is a true and correct copy of a scientific article published in the journal Food Control titled *First report on quality and purity evaluations of avocado oil in the US*, accessible at <https://www.sciencedirect.com/science/article/pii/S0956713520302449>.

5. Attached as **Exhibit 5** is a true and correct copy of an article published in the Washington Post titled *Why your avocado oil may be fake and contain other cheap oils*, accessible at <https://www.washingtonpost.com/wellness/2024/08/27/avocado-oil-adulteration-tests/>.

6. Attached as **Exhibit 6** is a true and correct copy of a Healthline article titled *Evidence-Based Health Benefits of Avocado Oil*, accessible at <https://www.healthline.com/nutrition/9-avocado-oil-benefits>.

7. Attached as **Exhibit 7** is a true and correct copy of a Chosen Foods article titled *Avocado Oil As A High Heat Cooking Oil*, accessible at

1 [https://chosenfoods.com/blogs/central/avocado-oil-as-a-high-heat-cooking-](https://chosenfoods.com/blogs/central/avocado-oil-as-a-high-heat-cooking-oil?srsltid=AfmBOooJ6z-STY_FaexT2wMWae5Lr4ak-pEDYsAQPIVN20yvbhw9P1jV)  
2 [oil?srsltid=AfmBOooJ6z-STY\\_FaexT2wMWae5Lr4ak-pEDYsAQPIVN20yvbhw9P1jV.](https://chosenfoods.com/blogs/central/avocado-oil-as-a-high-heat-cooking-oil?srsltid=AfmBOooJ6z-STY_FaexT2wMWae5Lr4ak-pEDYsAQPIVN20yvbhw9P1jV)

3 8. Attached as **Exhibit 8** is a true and correct copy of a Healthline article titled  
4 *Canola Oil vs. Vegetable Oil: What's Healthiest?*, accessible at  
5 <https://www.healthline.com/health/food-nutrition/canola-vs-vegetable-oil>.

6 9. A true and correct copy of an image of the front of a bottle of Great Value  
7 Avocado Oil is attached as **Exhibit 9**. The front of Walmart's bottle prominently states  
8 "Avocado Oil," and includes images of avocados:



1           10.     A true and correct copy of an image of the back of the Great Value  
2 Avocado Oil is attached as **Exhibit 10**. The back of the label lists only a single ingredient:  
3 Avocado Oil.



21           11.     Dovel & Luner has been appointed lead counsel in multiple other cases and  
22 have successfully resolved—both through settlement and trial—consumer class actions.  
23 *See, e.g., Goodrich, et al. v. Alterra Mountain Co., et al.*, No. 1:20-cv-01057-RM-SKC (D.  
24 Colo.), Dkt. 157 (granting final approval of a \$17.5 million settlement in a consumer class  
25 action); *Barr et al. v. Select Blinds, LLC*, No. 2:22-cv-08326-SPG-PD (C.D. Cal.), Dkt. 56  
26 (granting final approval of a \$10 million settlement in a consumer class action). For  
27 example, the Dovel lawyers were appointed co-lead counsel (among four competing  
28 groups) in a consumer protection class action in the District of Colorado. *Kramer v.*

1 *Alterra Mt. Co.*, 2020 U.S. Dist. LEXIS 135770, at \*8 (D. Colo.). The team was appointed  
2 for its “specific substantive investigation, research, and analysis already conducted to  
3 support and prosecute the claims on behalf of putative class members.” *Id.* at \*8.

4 12. Dovel & Luner was also appointed class counsel (or interim counsel) in  
5 *Damonie Earl et al. v. The Boeing Company*, No. 4:19-cv-00507 (E.D. Tex.) (a multi-billion-  
6 dollar RICO class action against Boeing and Southwest); and *In re: Arch Insurance Company*  
7 *Ski Pass Insurance Litigation*, MDL No. 2955 (W.D. Mo.) (an insurance coverage class  
8 action). Dovel & Luner serves on the leadership committee in *In re: Simulated Casino-Style*  
9 *Games Litigation*, No. 5:21-md-02985-EJD (N.D. Cal.) (a class action asserting that Apple,  
10 Google, and Facebook provide illegal social gambling applications).

11 13. Dovel also has the rare ability to try complex class actions to verdict. In  
12 April of 2019, Dovel lawyers obtained a \$925 million jury verdict in a TCPA class action  
13 pending in the District of Oregon. *Wakefield v. Visalus, Inc.*, No. 3:15-cv-1857- SI, 2020  
14 U.S. Dist. LEXIS 146959 (D. Or. Aug. 14, 2020).

15 14. Dovel & Luner has no conflicts with class members and is committed to  
16 vigorously prosecuting this case.

17 15. Dovel & Luner engaged Ceutical Labs to perform additional testing on a  
18 sample of Great Value Avocado Oil. A true and correct copy of the testing results are  
19 attached as **Exhibit 11**. Consistent with the UC Davis testing, these test results  
20 confirmed that the avocado oil was mixed with other cooking oils. The laboratory  
21 informed us that avocado oil does not have any C20 Fatty Acid, but the testing results  
22 show the presence of C20, C20.1, C20.2, and C20.3, which indicates the presence of other  
23 cooking oils.

24 I declare under penalty of perjury that the foregoing is true and correct. Executed  
25 this 8th day of January, 2025, at Los Angeles, California.

26  
27 Dated: January 8, 2025

/s/ Richard Lyon

Richard Lyon

# EXHIBIT 1



Chobani. Tasty holidays start here The perfect recipe companion.

Sponsored ⓘ



Popular pick for "avocado oil great value"

Great Value

Great Value Refined Avocado Oil, 25.5 fl oz

★★★★☆ (4.2) | 304 ratings

Ingredients

About this item

Great Value Refined Avocado Oil, 25.5 fl oz:

- 25.5 fl oz bottle of refined avocado oil
- Mild flavor and a relatively high smoke point
- Use to saute, stir-fry or pan fry your favorite foods
- Add to homemade marinades or salad dressings
- About 50 servings per container



Tasty holidays start here

Make new recipe traditions with Chobani®.

Shop now

Chobani

Sponsored

Fakespot Review Analysis



Analyze this product

\$9.72 38.1 c/fl oz

Price when purchased online ⓘ

Free 90-day returns

Add to cart



Subscribe

\$9.72

Your usuals, on your schedule  
Save time and stay stocked!

[How it works](#)



One-time purchase

\$9.72

How do you want your item?



I want shipping & delivery savings with

Walmart+

You get 30 days free! Choose a plan at checkout.



Shipping  
Arrives Dec 20



Pickup  
Today



Delivery  
Today

New!

Pickup from Hawthorne Neighborhood Market



Aisle A10

Delivery to Santa Monica, 90401



Sold and shipped by Walmart.com



Free 90-day returns [Details](#)



This item is gift eligible [Learn more](#)



EBT eligible



Add to list



Add to registry



Sponsored

\$65.00

C60olive - Carbon 60 (Fullerene)...

3+ day shipping

+ Add

Similar items you might like

Based on what customers bought



Best seller



Best seller




Best seller



Best seller





+ Add

Sponsored


**\$13.37** 26.2 ¢/fl oz

Olivari Grapeseed Oil, Cooking Oil for Frying & Sauteing, 51 fl oz

★★★★☆ 142

Save with W+

Pickup today  
Delivery today  
Shipping, arrives tomorrow



+ Add

Sponsored


**\$7.98** 15.6 ¢/fl oz

Iberia Premium Blend Sunflower Oil & Extra Virgin Olive Oil 51 fl oz

★★★★☆ 112

Save with W+

Pickup today  
Delivery today  
Shipping, arrives tomorrow



+ Add


**\$14.12** 55.6 ¢/fl oz

Chosen Foods 100% Pure Avocado Oil, 25.4 Floz Glass Bottle, Non-GMO

★★★★☆ 670

Save with W+

Pickup today  
Delivery today  
Shipping, arrives in 3+ days



+ Add

**\$19.48** 38.2 ¢/fl oz

Tropical Plantation 100% Pure Avocado Oil, 51 fl oz


★★★★☆ 148

Save with W+

Pickup today  
Delivery today  
Shipping, arrives tomorrow

## 4 stars and above

Based on customer ratings and number of reviews



✓ ?

Best seller

+ Add


**\$11.48** 67.9 ¢/fl oz

Carapelli Organic Extra Virgin Olive Oil, 16.9 fl oz

★★★★☆ 156

EBT EBT eligible

1-day shipping



✓ ?

Best seller

+ Add


**\$7.22** 60.2 ¢/fl oz

Chosen Foods 100% Pure Avocado Oil-Based Classic Mayonnaise Jar, 12 fl oz

★★★★☆ 79

EBT EBT eligible

Pickup Delivery 1-day shipping



✓ ?

+ Add


**\$19.97** 78.3 ¢/fl oz

Partanna Organic Unfiltered Extra Virgin Olive Oil, 25.5 fl oz

★★★★☆ 44

EBT EBT eligible

1-day shipping



✓ ?

+ Add


**\$14.12** 55.6 ¢/fl oz

Chosen Foods 100% Pure Avocado Oil, 25.4 Floz Glass Bottle, Non-GMO

★★★★☆ 670

EBT EBT eligible

Pickup Delivery 3+ day shipping




✓ ?

3+ day shipping

+ Add

## More items to consider

Based on what customers bought



✓ F

+ Add


**\$7.48** 42.5 ¢/oz

Morton Salt Himalayan Pink Salt, Fine - for Baking, Blending and More (17.6 oz)

★★★★☆ 346

Save with W+

Pickup today  
Delivery today  
Shipping, arrives tomorrow



✓ A

Best seller

+ Add


**\$5.63** ~~\$36.72~~ 32.0 ¢/oz

Great Value Fine Himalayan Pink Salt, 17.6 oz

★★★★☆ 48

Save with W+

Pickup today  
Delivery today  
Shipping, arrives tomorrow



✓ G

+ Add


**\$6.86** 42.9 ¢/oz

Himalayan Chef Pink Salt 1lb Bag

★★★★☆ 119

Save with W+

Pickup today  
Delivery today  
Shipping, arrives tomorrow



✓ A

Rollback

+ Add

**Now \$9.84** ~~\$16.98~~ 30.8 ¢/oz

Great Value Superfine Blanched Almond Flour, 2 lb

★★★★☆ 534

Save with W+

Pickup today  
Delivery today  
Shipping, arrives in 2 days

## About this item

Nutrition information


Product details

Enjoy the health benefits and versatility of Great Value Refined Avocado Oil. This 25.5 fluid ounce bottle with a screw top lid is ideal for keeping near your stovetop for use in all your recipes. Use this pure avocado oil to keep your stir-fries from sticking, to make a homemade salad dressing, or to drizzle on a Caprese salad. Substitute avocado oil for olive oil or vegetable oil in baking recipes. Avocado oil has a mild flavor and a relatively high smoke point, making it a great choice for cooking foods at high heat. Add it to a marinade for meats or brush vegetables with it to cook on the grill. Saute or pan fry your favorite dishes like chicken cutlets, dumplings, or fish. Make regular use of this shelf-stable and nutritious Great Value Refined Avocado Oil.

Great Value products provide families with affordable, high-quality grocery and household consumable options. With our wide range of product categories spanning grocery and household consumables, we offer you a variety of products for your family's needs. Our products are conveniently available online and in Walmart stores nationwide, allowing you to stock up and save money at the same time.


Great Value Refined Avocado Oil, 25.5 fl oz:

- 25.5 fl oz bottle of refined avocado oil
- Mild flavor and a relatively high smoke point
- Use to saute, stir-fry or pan fry your favorite foods
- Add to homemade marinades or salad dressings
- About 50 servings per container

 We aim to show you accurate product information. Manufacturers, suppliers and others provide what you see here, and we have not verified it. [See our disclaimer](#)

Compare with similar items

Viewing this item




+ Add

\$9.72

Great Value Refined Avocado Oil, 25.5 f...

★★★★☆ 304




+ Add

\$14.12

Chosen Foods 100% Pure Avocado Oil...

★★★★★ 670




+ Add

\$19.48

Tropical Plantation 100% Pure Avocad...

★★★★★ 148




+ Add

\$5.37

Pompeian Grapeseed Oil - 24...

★★★★★ 317



+ Add

\$10.48

Spectrum Naturals Cold Pressed...

★★★★★ 10

Flavor	Unflavored	Unflavored	Unflavored	Grapeseed	Refined
Count	1	1	1	1	1
Nutrients	Trans Fat-Free	Kosher	Superfood	Corn-Free	Cold Pressed
Food preparation method	Refined	Refined	Cold Pressed	Filtered	Cold Pressed

See More

Specifications

Container Material

Plastic

Cooking Oil Type

Avocado Oils

Third Party Accreditation Symbol on Product Package Code

Kosher Certification Service

Nutrient Content Claims

Trans Fat-Free

[More details](#)

Directions

Safe Handling Instructions

OVERHEATED OILS MAY CAUSE FIRE. IF OIL SMOKES REDUCE HEAT. CAP WHEN NOT IN USE.

Ingredients

 [Report incorrect product information](#)

Refine your search

avocado oil spray

chosen foods avocado oil

organic avocado oil

avocado oil mayo

chosen avocado oil

avocado oil unrefined

avocado oil glass bottle

great value avocado oil

avocado oil mayonnaise

cold pressed avocado oil

Products you may also like












Best seller



Best seller

Sponsored





+ Add

**\$5.76** 28.8 ¢/fl oz

Litehouse Creamy Avocado Ranch Refrigerated Salad Dressing, 20 Fluid oz Bottle

★★★★★ 2

EBT EBT eligible

Pickup Delivery



+ Add

**\$2.88** 12.0 ¢/fl oz

WESSON Pure & Cholesterol Free Canola Oil, 24 fl oz

★★★★☆ 63

EBT EBT eligible

Pickup Delivery



+ Add

**\$15.00** 93.8 ¢/fl oz

Spectrum Naturals Refined Walnut Oil, 16 fl oz

★★★★★ 160

3+ day shipping



+ Add

**\$7.22** 60.2 ¢/fl oz

Chosen Foods 100% Pure Avocado Oil-Based Classic Mayonnaise Jar, 12 fl oz

★★★★☆ 79

EBT EBT eligible

Pickup Delivery 1-day shipping

## Customer ratings & reviews

4.2 out of 5

★★★★☆ 304 ratings | 129 reviews

How item rating is calculated ⓘ

View all reviews



All filters ▾

☆ Star rating ▾

Verified purchases only

Sort by | Most relevant ▾

Taste (23)

Price (21)

Value (10)

Bottle (9)

Cooking (9)

Quality (8)

Cap (6)

Package (5)

Design (4)

Baking (4)

Showing 1-3 of 129 reviews

Sep 12, 2023

★★★★★ Verified Purchase ⓘ

Ann

**WAY TO GO**

Avocado oil is by far the best tasting oil there is whether to fry or for salad dressing, this is the oil to buy, and is good for you too. This is a good far just like olive oil except it taste much better. In any case, the olive oil they sell in the US is not the best oil. We get the bottom of the barrel so to speak. The best olive oil stays...

[Read more](#)

Helpful?  | [Report](#)

Nov 16, 2024

★★★★★ Verified Purchase ⓘ

Judy

i do like using this oil for cooking eggs, etc

Helpful?  | [Report](#)

Dec 7, 2019

★★★★★

Jessica

**Healthy Choice**

This is my go to oil. Learning that only extra virgin olive oil is the healthy of the olive oils, and avocado I chose this one since I am sensitive to olives. I used to use grapeseed oil thinking that was healthy until I shared what I used with my children's pediatrician and she said that it wasnt good. Like most oils you dont...

[Read more](#)

Helpful?  | [Report](#)

View all reviews (129)



**Debit with rewards.** Get 3% cash back at Walmart, up to \$50 a year. See terms for eligibility. [Learn more.](#)

**Chobani.**

Tasty holidays start here

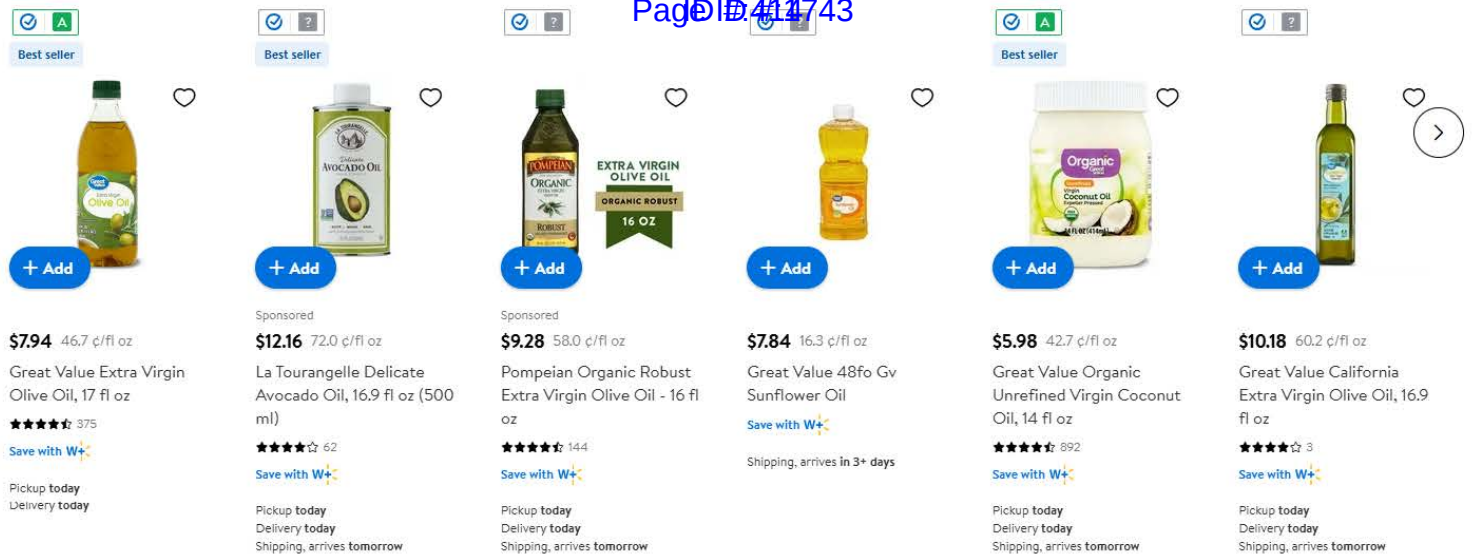
Make new recipe traditions with Chobani®.

Shop now

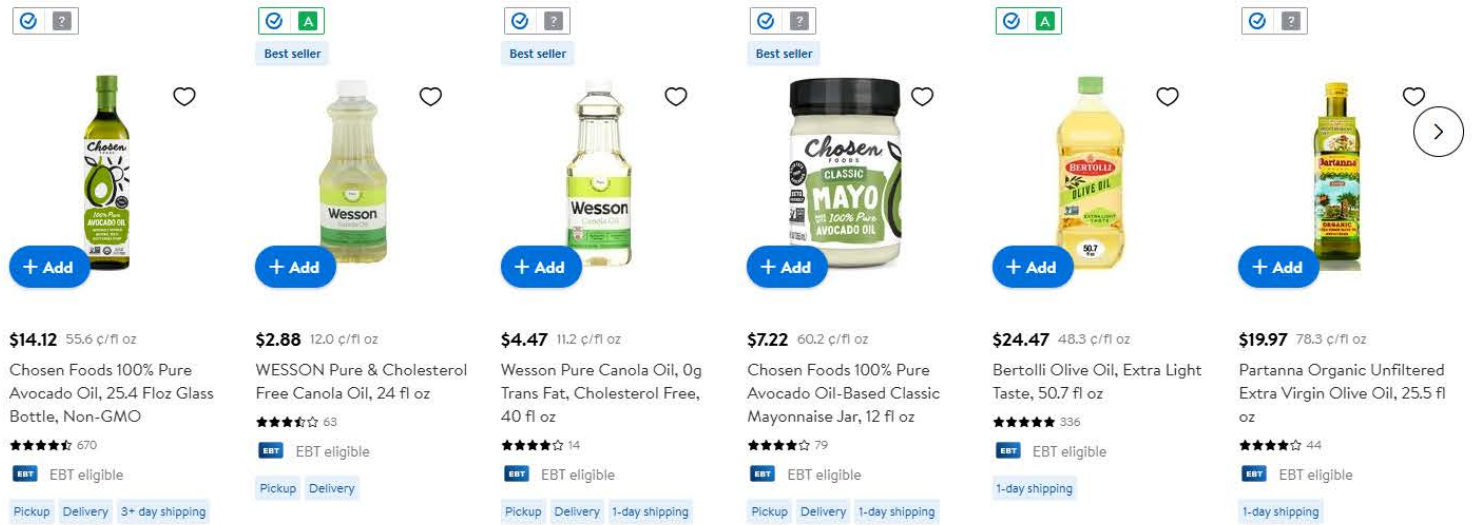


Sponsored ⓘ

Customers also considered

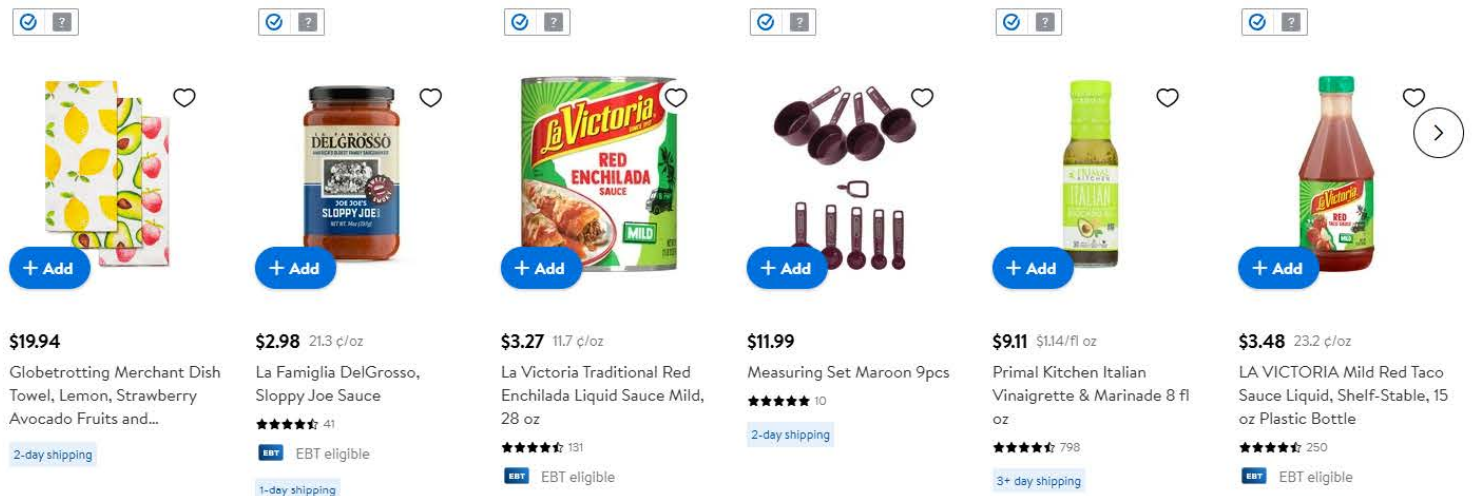


### More items to explore



A promotional banner for Chobani. On the left, the Chobani logo is displayed above the text "Tasty holidays start here" and "Make new recipe traditions with Chobani®". Below this is a "Shop now" button. On the right, a large chocolate cake with a slice removed sits on a glass platter. Next to it is a container of Chobani Greek Yogurt and a small glass of yogurt with fruit. The background is a festive blue with white snowflakes.

### Products related to this item



## Related pages

[Great Cooking](#)

[Vegetable Oil Make](#)

[Cooking oils](#)

[Corn oils](#)

[Vegetable O](#)

[Baking Avocado Oil](#)

[Avocado oils](#)

[Olive oils](#)

[5 Gallon Vegetable Oil](#)

[Admiration Foods](#)

[Olive oil](#)



# EXHIBIT 2

Chobani. Tasty holidays start here The perfect recipe companion.

Sponsored ⓘ



Nutrition Facts	
Total Fat	17 1/2g
Sodium	2mg
Total Crap	120

INGREDIENTS: SOYBEAN OIL



Best seller Popular pick for "vegetable oil"

Great Value

Great Value Vegetable Oil, 48 fl oz

★★★★☆ (4.2) | 1,945 ratings

Ingredients

About this item

- Great Value Vegetable Oil, 48 fl oz
- Great for frying, baking, and making salad dressings
- Good for high-heat cooking
- Neutral flavor
- Essential pantry staple
- Contains 96 servings



Tasty holidays start here

Make new recipe traditions with Chobani®.

Shop now

Chobani.

Sponsored

Fakespot Review Analysis



Reanalyze this product

\$4.37 9.1 ¢/fl oz

Price when purchased online ⓘ

Free 90-day returns

Add to cart



Subscribe

\$4.37



Your usuals, on your schedule  
Save time and stay stocked!

[How it works](#)



One-time purchase

\$4.37

How do you want your item?

☐ I want shipping & delivery savings with

Walmart+

You get 30 days free! Choose a plan at checkout.



Shipping  
Out of stock



Pickup  
Today



Delivery  
Today

New!

Pickup from Hawthorne Neighborhood Market

📍 Aisle A10

Delivery to Santa Monica, 90401

EBT

EBT eligible



Add to list



Add to registry

Similar items you might like

Based on what customers bought



+ Add

Sponsored



Best seller



+ Add



Best seller



+ Add



+ Add



Add to cart

How do you want your item?

☐ I want shipping & delivery savings with

Walmart+

You get 30 days free! Choose a plan at checkout.



Shipping  
Out of stock



Pickup  
Today



Delivery  
Today

New!

Pickup from Hawthorne Neighborhood Market

\$12.28 9.6 ¢/fl oz

Wesson Pure & Cholesterol Free Soybean Vegetable Oil, 128 fl oz

★★★★☆ 168

Save with W+

Pickup today  
Delivery today  
Shipping, arrives tomorrow

\$4.47 11.2 ¢/fl oz

Wesson Pure & Cholesterol Free Soybean Vegetable Oil, 40 fl oz

★★★★☆ 15

Save with W+

Pickup today  
Delivery today  
Shipping, arrives tomorrow

\$7.94 46.3 ¢/fl oz

Great Value Extra Virgin Olive Oil, 17 fl oz

★★★★☆ 375

Save with W+

Pickup today  
Delivery today

\$7.84 16.3 ¢/fl oz

Great Value 48fo Gv Sunflower Oil

Save with W+

Shipping, arrives in 3+ days

Aisle A10

Delivery to **Santa Monica, 90401**

## 4 stars and above

Based on customer ratings and number of reviews

Sponsored



+ Add



+ Add



+ Add



+ Add

\$15.48 45.5 ¢/fl oz

Terra Delyssa Organic Extra Virgin Olive Oil, 34 fl. oz. Glass

★★★★☆ 414

EBT EBT eligible

3+ day shipping

\$24.47 48.3 ¢/fl oz

Bertolli Cooking Olive Oil, 50.7 fl oz

★★★★☆ 171

EBT EBT eligible

1-day shipping

\$12.28 9.6 ¢/fl oz

Wesson Pure & Cholesterol Free Soybean Vegetable Oil, 128 fl oz

★★★★☆ 168

EBT EBT eligible

Pickup Delivery 1-day shipping

\$24.47 48.3 ¢/fl oz

Bertolli Olive Oil, Extra Light Taste, 50.7 fl oz

★★★★☆ 336

EBT EBT eligible

1-day shipping

## More items to consider

Based on what customers bought



Best seller



+ Add



Best seller



+ Add



+ Add



Best seller



+ Add

\$2.52 31.5 ¢/oz

Great Value Original Cooking Spray, 8 ounces

★★★★☆ 736

Save with W+

Pickup today  
Delivery today

Sponsored

\$4.47 11.2 ¢/fl oz

Wesson Pure & Cholesterol Free Soybean Vegetable Oil, 40 fl oz

★★★★☆ 15

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Pickup today  
Delivery today  
Shipping, arrives tomorrow

\$6.48 13.5 ¢/oz

Great Value All Vegetable Shortening, 48 oz Can

★★★★☆ 233

Save with W+

Pickup today  
Delivery today

+2 options

\$0.62 2.4 ¢/oz

Great Value Iodized Salt, 26 oz

★★★★☆ 1174

Save with W+

Pickup today  
Delivery today

## About this item


Nutrition information

Product details

Great Value Vegetable Oil is the perfect choice for all of your cooking needs. The 48-ounce bottle contains 96 servings with only 120 calories and two grams of saturated fat per serving. Plus, the value size bottle is only a fraction of the cost of name brand vegetable oils. This versatile cooking oil contains only soybean oil with no preservatives. It is also gluten free and Kosher certified. With a higher smoke point than other oils, vegetable oil is great for frying and baking. You can also use this oil as a blank canvas for yummy salad dressings. Oil made from soybeans is rich in fatty acids, antioxidants, and essential vitamins and minerals. Regardless of what you're cooking, you can be certain you're making a healthy choice when you use Great Value Vegetable Oil.


Great Value products provide families with affordable, high quality grocery and household consumable options. With our wide range of product categories spanning grocery and household consumables, we offer you a variety of products for your family's needs. Our products are conveniently available online and in Walmart stores nationwide, allowing you to stock up and save

- Great Value Vegetable Oil, 48 fl oz
- Great for frying, baking, and making salad dressings
- Good for high-heat cooking
- Neutral flavor
- Essential pantry staple
- Contains 96 servings

 We aim to show you accurate product information. Manufacturers, suppliers and others provide what you see here, and we have not verified it. [See our disclaimer](#)

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\$4.37

Great Value Vegetable Oil, 48 f...

★★★★☆ 1946




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\$12.28

Wesson Pure & Cholesterol Free...

★★★★☆ 168




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\$4.47

Wesson Pure & Cholesterol Free...

★★★★☆ 15




+ Add

\$7.94

Great Value Extra Virgin Olive Oil, 17 ...

★★★★☆ 375



+ Add

\$14.32

(4 pack) 1-2-3 Vegetable Oil, 33.8...

★★★★☆ 55

Flavor	Unflavored	Unflavored	Unflavored	Unflavored	Unflavored
Count	1	1	1	1	1
Dietary method	Vegan	Vegan	Kosher	Vegetarian	Kosher
Allergen-free statements	Gluten-Free	Gluten-Free	Gluten-Free	Gluten-Free	Dairy-Free

See More

Specifications

Container Material

Plastic

Features

No trans fat, 100% pure, No artificial flavors or colors

Cooking Oil Type

Vegetable Oils

Third Party Accreditation Symbol on Product Package Code

Kosher Certification Service

[More details](#)

Directions

Instructions

Store at room temperature.

Safe Handling Instructions


CAUTION: ANY OIL WILL BURN IF OVERHEATED. DO NOT LEAVE UNATTENDED WHILE HEATING. IF OIL SMOKES, REDUCE HEAT. IF FIRE OCCURS, TURN OFF HEAT AND COVER UNTIL COOL. DO NOT PUT WATER ON HOT OR FLAMING OIL. DO NOT POUR HOT OIL INTO THIS CONTAINER AS DAMAGE MAY OCCUR, CAUSING INJURY.

Ingredients


Warnings


Warning Text


CAUTION: ANY OIL WILL BURN IF OVERHEAD. DO NOT LEAVE UNATTENDED WHILE HEATING. IF OIL SMOKES, REDUCE HEAT. IF FIRE OCCURS, TURN OFF HEAT AND COVER UNTIL COOL. DO NOT PUT WATER ON HOT OR FLAMING OIL. DO NOT POUR HOT OIL INTO THIS CONTAINER. DAMAGE CAN OCCUR, CAUSING INJURY.


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 great value oil canola


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 great value oil spray


 great value oil grapeseed

 great value oil small

 great value vegetable oil

 great value oil scented





+ Add


**\$4.47** 11.2 ¢/fl oz

Wesson Pure & Cholesterol Free Soybean Vegetable Oil, 40 fl oz

★★★★☆ 15

EBT EBT eligible

Pickup Delivery 1-day shipping



+ Add


**\$12.28** 9.6 ¢/fl oz

Wesson Pure & Cholesterol Free Soybean Vegetable Oil, 128 fl oz

★★★★☆ 168

EBT EBT eligible

Pickup Delivery 1-day shipping



+ Add


**\$2.88** 12.0 ¢/fl oz

WESSON Pure & Cholesterol Free Canola Oil, 24 fl oz

★★★★☆ 63

EBT EBT eligible

Pickup Delivery



+ Add

**\$4.47** 11.2 ¢/fl oz

Wesson Pure Canola Oil, 0g Trans Fat, Cholesterol Free, 40 fl oz

★★★★☆ 14

EBT EBT eligible

Pickup Delivery 1-day shipping

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Verified purchases only

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Frying (27)

Oil (23)

Baking (13)

Size (10)

Salads (8)

Showing 1-3 of 774 reviews

Jun 8, 2024

★★★★★ Verified Purchase ⓘ

Ethel

**Great Job!**

Kressee did a great, great job fetteing everything in order, including t g e substitutions. The only thing I would caution her on is .....she left the groceries at the wrong door. Left at groceriers at 506 and my apartment is 504. Luckily I have Great neighboros abd not anything was bothered. Otherwise, sge did a...

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Jun 12, 2024

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Marsha

**Nice guy.**

What a nice guy the delivery man was. He was very accomodating, as he came in and put the groceries on the kitchen table for me. I really appreciated him for that extra step.

Helpful?  (0)  (0) | [Report](#)

Feb 16, 2024

★★★★★ Verified Purchase ⓘ

Marilyn

**shoppers guide**

I'm loving shopping for groceries online it saves me the hassle or going to the grocery store standing in long lines and crowds If they get something wrong with your order they will gladly refund your order money back lines and crowds If they get something wrong with your order they will gladly refund your order money back on your card also replacement it next day and if there not in stock what you asking for by shipping it to you...

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Check Plaid Kitchen Towel -  
Soft Cotton - Washcloths - ...

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BENTISM Pan and Pot Rack  
Organizer Expandable  
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Enamel Aluminum Saute Pa...

★★★★★ 79

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# EXHIBIT 3



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# Food Control

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## Purity and quality of private labelled avocado oil

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Department of Food Science and Technology, University of California Davis, Davis, CA, 95616, USA

### ARTICLE INFO

#### Keywords:

Avocado oil  
Purity  
Quality  
Adulteration  
Standards  
Private label

### ABSTRACT

Avocado oil continues to be a high demand product and there is a growing market for both name brands and private labels. Since our study on evaluating the purity and quality of name brand avocado oil in 2020, some producers have made efforts to assure quality and lend support for standard establishment. However, the purity and quality of private labeled avocado oil have not been evaluated and are of a concern for many consumers. This study evaluates thirty-six private label samples throughout the US and Canada. Out of 29 refined samples, three met both quality and purity standards, 11 met quality standards and eight met current proposed purity standards; out of 7 unrefined samples, three met current proposed purity standards for avocado oil. Key markers such as an elevated stearic fatty acid value with an elevated delta-7-stigmastenol value were identified to help professional buyers make educated decisions on what oils to purchase. Low cost can indicate a higher probability for adulteration; however, high cost does not guarantee a pure sample of appropriate quality. Both purity and quality parameters should be used to label the avocado oil appropriately to ease consumer confusion and increase their confidence in the avocado oil category. This work also highlighted the importance of continuing to research avocado oil, to understand natural variables that affect chemical compositions of avocado oil and to establish standards that accommodate these variances while minimizing adulterations.

### 1. Introduction

Avocado oil is in high demand by consumers because of its high content of monounsaturated fatty acids, much like olive oil, as well as having a neutral flavor profile (Woolf et al., 2009). Thus, the avocado oil industry has continued to expand over the last five years. Due to the continued rise in avocado oil popularity, it is now being sold as a product by many grocery stores under private label brands in addition to name brand products. Private label oils are products that are produced by a third-party processor (or brand) and sold under a certain grocery store label (or brand). This process may lead to more adulteration and fraud due to the increased number of steps and parties involved; if the fruit is processed into oil in one place, refined in another location, and labeled/bottled in a third place, adulteration has the potential to occur at any of those steps and some parties, like the professional buyer can be unaware when malpractices are taking place (Ehmke et al., 2019). It is not only necessary for these oils to be tested by third parties, but also for professional buyers to know what a pure avocado oil should look like in the Certificate of Analysis so that they can make the right choices in what oils to sell under their private label. Although product quality and traceability are important evaluation criteria of suppliers for private

label buyers, pricing is the decisive factor for most buyers. It costs more to make 100% authentic avocado oil than 100% soybean oil or a mix of 50% avocado oil and 50% high oleic sunflower oil so fraudulent suppliers could sell their products at a lower price than honest authentic avocado oil suppliers and still make more profit.

The formation of avocado oil standards by the international standard development organization, CODEX Alimentarius, formed by the World Health Organization (WHO) and Food and Agriculture Association (FAO), is well underway (Codex Alimentarius Commission, 2021a), however, this process takes time and the standards for refined avocado oil are still being finalized while a separate set of standards for virgin/extra virgin will likely need to be further developed. Due to avocado oil being a relatively new product, it is difficult with the current information available for professional buyers to make the right decisions on what to purchase. To address some of these issues, an evaluation of thirty-six private label oils currently on the market was done to determine their quality and purity and how they relate to proposed CODEX standards and pure samples in literature. This work also serves as a follow-up to our 2020 study on the evaluation of quality and purity of avocado oils in the US as we received many inquiries from consumers about private label oils, which were not the focus in the original study

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(Green & Wang, 2020). These private label oils were used to identify set of common markers of adulteration to help professional buyers to determine what oils to purchase. This includes a list of fatty acids and sterols and how increases or decreases in specific values can help buyers determine if there is adulteration occurring and if so, potentially with what oil. Techniques to assess oil quality were also discussed as well as issues with current labeling, which currently contains many contradictions. With this information, professional buyers can be more confident in choosing products that are pure and of good quality.

## 2. Materials and methods

### 2.1. Avocado oil samples

A total of 36 private label oils, which are oils bought from a third-party manufacturer but are sold under a retailer brand, were purchased from grocery stores across the US and Canada. Samples labeled as both refined (29) and virgin/extra virgin samples (7) were collected. If a sample did not have a specific label or had ambiguous labeling, like refined and cold-pressed or pure and cold-pressed, it was assumed to be refined. Each oil sample was stored in the dark at 20 °C and purged with nitrogen after each opening. Quality analyses were completed first upon opening to minimize changes in oil quality due to oxygen exposure. Table 1 contains information about each sample including their designated grade (refined vs. virgin/extra virgin), product origin, purchasing location, packaging, price and best by date. Samples were numbered and data organized according to sample label, with one group for refined oils and another for virgin/extra virgin. Table S1 contains a list of the private label brands that were analyzed in this study, in alphabetical order.

### 2.2. Quality parameters

Free fatty acidity (FFA), peroxide value (PV), and specific extinction in ultraviolet (UV) at 232 nm, 270 nm, and  $\Delta K$  were determined using AOCS methods Ca 5a-40 (09), Cd 8b-90 (09), and Ch 5-91 (09) ((American Oil Chemist's Society, 1998)), respectively.

### 2.3. Minor components

Tocopherols were determined according to Gimeno et al. (2000) with some modifications. Oil (40  $\mu$ L) and hexane (160  $\mu$ L) were briefly vortexed then the internal standard ( $\alpha$ -tocopheryl acetate, 300  $\mu$ g/mL in ethanol, purity 98%, Fisher Scientific Company LLC, USA) was added along with 600  $\mu$ L of methanol. The mixture was vortexed for 1 min and centrifuged for 5 min (5000 rpm, Beckman GS-15 R). Samples were stored at -20 °C for 2 h to allow oil to fully separate from the organic phase, which was then filtered with 0.45  $\mu$ m, nylon syringe filters. Analysis was performed on an Agilent 1290 Infinity II LC system with a diode-array detector using an Agilent ZORBAX Eclipse Plus C18 column (3.5  $\mu$ m, 3  $\times$  100 mm) with a methanol:water (96:4) isocratic mobile phase. A 20  $\mu$ L injection volume and flow rate of 1.0 mL min<sup>-1</sup> were used giving a total run time was 12 min. Diode-array detector (DAD) signal was recorded at 292 nm. All solvents used above were HPLC grade, from Fisher Scientific LLC, USA. Standard  $\alpha$ -tocopherol (>96%) was purchased from Fisher Scientific LLC, USA. Analytical grade standards  $\delta$ -tocopherol and  $\gamma$ -tocopherol were purchased from MilliporeSigma, USA. Gamma and beta tocopherols were quantified together.

### 2.4. Purity parameters

The IOC official method for the determination of the fatty acid

**Table 1**  
Information for each sample used in this study.

Code	Oil Label	Product origin	Place purchased	Packaging	Price/Oz (\$)	Best by date
1	Refined	Mexico	RI	Colored plastic	0.29	3/24/2022
2	Refined	Mexico	IA	Colored plastic	0.29	3/8/2022
3	Refined	Spain	BC, Canada	Colored glass	0.33	8/18/2022
4	Refined	USA, Mexico	IL	Colored glass	1.18	1/2/2022
5	Refined	USA, Mexico	NC	Colored glass	1.06	4/29/2022
6	Refined	Mexico, South Africa, France	TX	Colored glass	0.41	5/17/2022
7	Refined	Mexico, South Africa, France	CO	Colored glass	0.47	5/17/2022
8	Refined & expeller pressed	France	IL	Colored glass	0.53	3/1/2023
9	Refined & expeller pressed	France	RI	Colored glass	0.53	3/1/2023
10	Refined & expeller pressed	Mexico	RI	Clear glass	0.71	4/13/2023
11	Refined & expeller pressed	South Africa	CO	Clear glass	0.71	3/8/2023
12	Refined & expeller pressed	South Africa	CA	Clear glass	0.71	3/8/2023
13	Refined & expeller pressed	Mexico	CA	Clear glass	0.70	12/7/2022
14	Refined & expeller pressed	Mexico	MA	Colored glass	0.61	4/30/2022
15	Cold pressed & Refined	Spain	IL	Colored glass	0.42	10/1/2022
16	Cold pressed & Refined	Spain	MN	Colored glass	0.53	Unclear
17	Cold pressed & Refined	Mexico, Spain, USA	IL	Colored glass	0.50	9/25/2022
18	Cold pressed & Refined	Mexico, Spain, USA	IL	Colored plastic	0.50	9/1/2022
19	Unspecified	Mexico	BC, Canada	Colored glass	0.44	7/5/2022
20	Unspecified	Mexico	KS	Colored glass	0.59	2/25/2023
21	Unspecified	Mexico	MN	Colored glass	0.59	2/25/2023
22	Unspecified	Mexico	NC	Colored glass	0.55	12/31/2023
23	Unspecified	Mexico	IL	Colored glass	0.55	3/2/2023
24	Unspecified	Mexico	CA	Colored glass	0.47	3/25/2023
25	Unspecified	Mexico	RI	Colored glass	0.47	12/31/2021
26	Cold pressed	Spain	DC	Colored plastic	0.39	4/29/2023
27	Cold pressed	Mexico, Spain, USA	NC	Colored glass	0.24	2/28/2023
28	Cold pressed	Mexico, Spain, USA	IL	Colored glass	0.41	3/26/2023
29	Cold pressed	Mexico, Spain, USA	NC	Colored glass	0.29	10/23/2022
30	Virgin/Extra virgin	Mexico	ON, Canada	Colored glass	0.45	7/30/2022
31	Extra Virgin	Mexico	BC, Canada	Colored glass	0.54	8/31/2022
32	Extra virgin	Spain	RI	Colored glass	0.83	5/25/2023
33	Extra virgin	Spain	NJ	Colored glass	0.83	3/9/2023
34	Virgin	Mexico	RI	Clear glass	0.71	3/1/2023
35	Virgin	Mexico	CA	Clear glass	0.71	2/26/2023
36	Extra virgin	Mexico	NJ	Colored glass	0.83	4/30/2022

methyl esters by gas chromatography (COI/T.20/Doc. No 30/Rev.1, 2017) was used for fatty acid profile analysis with modifications. Approximately 20  $\mu\text{L}$  of oil was mixed with 3 mL heptane. Methanolic KOH, 2 M was added (200  $\mu\text{L}$ ) and vortexed for 1 min. Once the organic phase was clear, it was filtered with 0.45  $\mu\text{m}$  PTFE filter for analysis. The GC-FID analysis was performed on an Agilent 7890 A GC using a 90 m  $\times$  250  $\mu\text{m}$   $\times$  0.25  $\mu\text{m}$  DB-FastFAME capillary column (Agilent Technologies) to achieve the separation of individual fatty acids. Helium was used as the carrier gas at a flow rate of 1.9 mL min<sup>-1</sup> with an injection volume of 1.0  $\mu\text{L}$  and a split ratio of 30. The injector temperature was held at 260 °C. The GC oven program was held at 75 °C for 1 min; then ramped at 35 °C min<sup>-1</sup> to 200 °C and held for 14 min, followed by a ramp of at 2.5 °C min<sup>-1</sup> to 210 °C, which was held for 5 min. The last ramp was at 12 °C min<sup>-1</sup> to 230 °C and held for 20 min, giving a total run time of 49.2 min. The FID temperature was 260 °C. The detector gas consisted of hydrogen (flow rate: 40 mL min<sup>-1</sup>), air (flow rate: 400 mL min<sup>-1</sup>), and helium make up gas (flow rate: 25 mL min<sup>-1</sup>). Peak identification was performed using a 37-component FAME reference standard mix (MilliporeSigma).

Sterols content was analyzed using a combination of both Mathison and Holstege (2013) and the Phenomenex determination of sterols in olive oil (TN-0114) with modifications, which is described in more detail in Green and Wang (2023a). First, 20  $\mu\text{L}$  of internal standard 0.2%  $\alpha$ -cholestanol ethyl acetate solution was dried before adding 200 mg of oil and 1.5 mL of 2 M KOH in 95% ethanol. The mixture was capped and heated at 80 °C in two, 25 min increments. Once removed from the heat, 13.5 mL DI water was added and gently mixed before loading onto a Phenomenex Strata DE SLE cartridge, 60 cc tube, followed by two 1 mL rinses with DI water. A syringe packed with glass wool and 6–7 g sodium sulfate was attached to the bottom of the cartridge and after 15 min, five 15 mL portions of diethyl ether were passed through the cartridge. Eluents were dried using a rotary evaporator and then placed in an oven at 100 °C to remove water before reconstituting with 5 mL hexane. Next, the silica SPE columns (6 mL, 1 g sorbent, Agilent brand) were conditioned using two, 6 mL hexane rinses followed by 1 mL of 0.2 M KOH in 98% ethanol, followed by an additional 5 mL hexane rinse. Samples were loaded onto the columns and washed with 85 mL of hexane: diethyl ether (98:2) at 2 mL min<sup>-1</sup>. The sterols fraction was eluted using 5 mL of hexane: diethyl ether (80:20) followed by 5 mL of hexane: diethyl ether (60:40). Extracts were dried in a rotary evaporator and if needed placed in an oven at 100 °C to remove remaining water. Finally, 250  $\mu\text{L}$  of the silylation reagent (pyridine/hexamethyl disilazane/trimethylchlorosilane, 9:3:1, v/v/v) was added to prepare the trimethylsilyl ethers for GC injection. The GC-FID analysis was conducted on an Agilent 7890 A GC with a 30 m  $\times$  0.25 mm  $\times$  0.25  $\mu\text{m}$  DB-5 capillary column (Agilent Technologies). An injection volume of 1.0  $\mu\text{L}$  and helium as the carrier gas at a flow rate of 1.2 mL min<sup>-1</sup> was used. The injector temperature was held at 280 °C at a split ratio of 5. The GC oven program was held isothermally at 150 °C for 8 min; then ramped at 20 °C min<sup>-1</sup> to 290 °C and held for 20 min to obtain a total run time of 37.33 min. The FID temperature was 300 °C. The detector gas consisted of hydrogen (flow rate: 30 mL min<sup>-1</sup>), air (flow rate: 400 mL min<sup>-1</sup>), and helium make up gas (flow rate: 25 mL min<sup>-1</sup>). Peak identification was carried out with standards and sample chromatograms provided in the IOC official method for relative retention times. Quantification was performed using the peak area and concentration of the internal standard.

Triacylglycerols (TAGs) were separated and analyzed using the method described in Green et al. (2020). In brief, each oil was diluted to a final concentrate of 1% with 50/50 chloroform/MeOH and then analyzed with the Vanquish™ Flex UHPLC-CAD system (Thermo Fisher Scientific, Waltham, MA, USA). Analytes were separated on a Thermo Scientific™ Accucore™ C18 column (100 mm  $\times$  2.1 mm; 2.6  $\mu\text{m}$ ). The injection volume was 1  $\mu\text{L}$  with a 0.5 mL min<sup>-1</sup> flow rate. Mobile phase A (acetonitrile) and mobile phase B (isopropanol) were used according to the following gradient conditions: start, 10% B; 2 min, 10% B; 25 min,

40% B; 30 min, 60% B; 35 min, 90% B; 40 min, 50% B and 45 min 10% B. All solvents were HPLC grade from Fisher Scientific LLC, USA.

## 2.5. Statistical analysis

In all figures and tables the error bars represent the standard deviation. Principal component analysis was completed using Originlab Corporation software version “OriginPro 2016 Sr2” using TAGs as variables and 95% confidence ellipses around each PCA cluster.

## 3. Results and discussion

### 3.1. Purity parameters

#### 3.1.1. Fatty acid profile

Fatty acid profile is currently the most widely used purity determination method for edible oils. Table 2 shows the results of the fatty acid profile for the samples in this study. There were nine refined oils and three extra virgin oils that passed the current proposed CODEX purity standards, giving a total of 33% of the total samples to pass the fatty acid profile results. For most of the samples that failed, they failed on multiple different fatty acids, increasing the possibility that economically motivated adulteration (EMA) is the reason the profiles did not match the proposed avocado oil standards. Some trends within these failures can be seen, an elevated stearic fatty acid (C18:0) content is accompanied by a low palmitoleic fatty acid (C16:1) content. Most common adulterant oils, including high oleic sunflower oil, high oleic safflower oil, canola oil, and soybean oil have lower palmitoleic and higher stearic fatty acid content compared to avocado, so these can be used as potential adulteration markers. It is also more common for the palmitic (C16:0) fatty acid to be too low rather than too high if adulteration is occurring. These same trends were seen in the original 2020 study on avocado oils available in the US; a sample was most likely to fail stearic fatty acid (too high), which was often accompanied with a palmitoleic fatty acid that was too low (Green & Wang, 2020). Although avocado oil is characterized as having a high oleic fatty acid content, the range for oleic fatty acid is so wide (42–75) that this fatty acid alone cannot be reliably used as an indicator of adulteration.

Significant progress has been made by CODEX with input from academics and industry members to develop appropriate standards for the avocado oil fatty acid profile, but how much natural variables such as cultivars, harvest time, and geographic origins may affect fatty acids in pure avocado oil is still not completely understood. In addition, Green and Wang (2023a), highlighted that it is still unknown why some industry-made oils, typically refined oils, have higher stearic fatty acid than what has been seen in lab-made oils and in literature (Green & Wang, 2023a, Ozdemir & Topuz, 2004; Tan et al., 2017, Berasategi et al., 2012, Madawala et al., 2012). It is possible this is caused solely by economically motivated adulteration; however, it has not been investigated if the refining process could be causing this phenomenon.

While continued research is needed on stearic acid in avocado oil, Green and Wang (2022b) demonstrated that changing how oleic fatty acid is reported could aid in the detection of adulteration. Currently, oleic acid is calculated as the sum of 18:1 (n-7) and 18:1 (n-9). However, *cis*-vaccenic acid, which is C18:1 (n-7) was shown to be significantly higher in avocado oil than other seed oils, particularly high oleic safflower and high oleic sunflower oils. All the samples that had more than 5.5% *cis*-vaccenic acid met the fatty acids and sterols standards for avocado oil (data not shown). By reporting the content of these two isomers separately, as well as their sum, it would allow professional buyers to see if the *cis*-vaccenic acid content is low, and thus provide further evidence that an avocado oil may be adulterated with a seed oil.

#### 3.1.2. Sterols profile

The sterols profile is another purity determination method, which is used less often due to its high cost and analysis time. This method is

**Table 2**

Detailed fatty acid results reported as percent of total fatty acids. The proposed CODEX standards as of 2021 are listed above the samples. Any value in red does not fit within these current CODEX ranges.

Code	C16:0	C16:1	C18:0	C18:1	C18:2	C18:3	C20:0	C20:1	C22:0
CODEX 2021 Stds	11.0–26.0	4.0–17.1	0.1–1.3	42.0–75.0	7.8–19.0	0.5–2.1	ND–0.7	ND–0.3	ND–0.5
1	13.09 ± 0.01	3.6 ± 0.0	2.24 ± 0	66.82 ± 0.02	12.66 ± 0.0	0.56 ± 0.0	0.36 ± 0.0	0.25 ± 0.0	0.26 ± 0.01
2	11.28 ± 0.05	2.67 ± 0.0	2.31 ± 0.05	69.71 ± 0.1	12.53 ± 0.02	0.42 ± 0.0	0.38 ± 0.0	0.27 ± 0.0	0.28 ± 0.02
3	12.33 ± 0.02	3.06 ± 0.0	2.11 ± 0.0	66.94 ± 0.05	13.94 ± 0.01	0.5 ± 0.0	0.36 ± 0.02	0.24 ± 0.01	0.37 ± 0.01
4	14.54 ± 0.03	4.81 ± 0.0	1.3 ± 0.02	59.66 ± 0.02	18.14 ± 0.01	0.86 ± 0.01	0.22 ± 0.01	0.22 ± 0.0	0.12 ± 0.0
5	14.5 ± 0.03	4.8 ± 0.0	1.28 ± 0.01	59.77 ± 0.13	18.12 ± 0.05	0.84 ± 0.03	0.22 ± 0.01	0.22 ± 0.0	0.11 ± 0.0
6	13.9 ± 0.01	5.12 ± 0.0	1.41 ± 0.01	59.48 ± 0.02	16.91 ± 0.0	2.16 ± 0.0	0.28 ± 0.0	0.39 ± 0.0	0.22 ± 0.0
7	13.77 ± 0.0	5.06 ± 0.0	1.43 ± 0.0	59.23 ± 0.04	17.25 ± 0.03	2.2 ± 0.0	0.28 ± 0.0	0.40 ± 0.0	0.22 ± 0.0
8	16.53 ± 0.16	7.48 ± 0.02	0.92 ± 0.17	62.85 ± 0.23	11.08 ± 0.07	0.76 ± 0.01	0.07 ± 0.01	0.15 ± 0.0	ND
9	16.38 ± 0.04	7.49 ± 0.01	0.79 ± 0.01	62.98 ± 0.03	11.16 ± 0.02	0.78 ± 0.02	0.08 ± 0.0	0.16 ± 0.0	0.03 ± 0.04
10	14.87 ± 0.1	5.69 ± 0.0	1.17 ± 0.07	58.85 ± 0.02	18.04 ± 0.08	0.66 ± 0.01	0.2 ± 0.03	0.21 ± 0.02	0.16 ± 0.01
11	18.58 ± 0.02	8.2 ± 0.02	0.73 ± 0.0	59.58 ± 0.03	11.61 ± 0.01	0.75 ± 0.0	0.15 ± 0	0.19 ± 0.0	0.06 ± 0.0
12	18.57 ± 0.01	8.19 ± 0.01	0.74 ± 0.0	59.6 ± 0	11.61 ± 0.01	0.75 ± 0.0	0.16 ± 0.01	0.19 ± 0.0	0.04 ± 0.0
13	13.8 ± 0.01	4.99 ± 0.0	1.51 ± 0.01	58.83 ± 0.06	17.43 ± 0.02	2.21 ± 0.0	0.35 ± 0.0	0.42 ± 0.0	0.31 ± 0.08
14	14.19 ± 0.01	4.5 ± 0.0	1.21 ± 0.01	55.27 ± 0.02	23.31 ± 0	0.88 ± 0.0	0.2 ± 0.0	0.22 ± 0.0	0.10 ± 0.0
15	11.43 ± 0.0	1.79 ± 0.0	2.56 ± 0.02	70.9 ± 0.01	11.71 ± 0.0	0.57 ± 0.0	0.43 ± 0.0	0.27 ± 0.02	0.20 ± 0.01
16	11.32 ± 0.03	1.77 ± 0.0	2.56 ± 0.01	71.14 ± 0.04	11.58 ± 0.0	0.57 ± 0.0	0.44 ± 0.01	0.27 ± 0.02	0.22 ± 0.01
17	11.07 ± 0.07	1.58 ± 0.0	2.67 ± 0.05	71.08 ± 0.09	11.82 ± 0.01	0.67 ± 0.0	0.39 ± 0.02	0.29 ± 0.0	0.31 ± 0
18	11.23 ± 0.02	1.9 ± 0.01	2.71 ± 0.01	71.43 ± 0.05	11.01 ± 0.01	0.57 ± 0.0	0.4 ± 0.01	0.27 ± 0.0	0.36 ± 0.03
19	17.02 ± 0.01	6.87 ± 0.01	1.32 ± 0.02	57.3 ± 0.04	15.93 ± 0.01	0.79 ± 0.0	0.27 ± 0.0	0.22 ± 0.0	0.12 ± 0.03
20	15.51 ± 0.26	4.99 ± 0.08	1.48 ± 0.01	65.15 ± 0.61	11.35 ± 0.21	0.76 ± 0.01	0.26 ± 0.01	0.23 ± 0.01	0.12 ± 0.02
21	15.28 ± 0.02	4.93 ± 0.0	1.43 ± 0.0	65.66 ± 0.02	11.21 ± 0.0	0.75 ± 0.0	0.26 ± 0.0	0.23 ± 0	0.09 ± 0.02
22	14.71 ± 0.02	6.27 ± 0.0	0.9 ± 0.03	63.55 ± 0.02	13.09 ± 0.0	0.78 ± 0.02	0.19 ± 0.0	0.2 ± 0.0	0.18 ± 0.0
23	11.01 ± 0.0	1.59 ± 0.0	2.74 ± 0.01	73.41 ± 0.03	9.74 ± 0.0	0.45 ± 0.0	0.36 ± 0.01	0.26 ± 0.0	0.31 ± 0.02
24	9.79 ± 0.01	1.39 ± 0.0	2.66 ± 0.01	73.85 ± 0.03	10.59 ± 0.0	0.55 ± 0.0	0.37 ± 0.0	0.29 ± 0.0	0.39 ± 0.01
25	13.41 ± 0.02	2.91 ± 0.0	1.96 ± 0.0	64.61 ± 0	15.63 ± 0.0	0.61 ± 0.0	0.32 ± 0.0	0.23 ± 0.0	0.2 ± 0.03
26	10.88 ± 0.03	1.62 ± 0.0	2.79 ± 0.03	69.88 ± 0.07	12.98 ± 0.0	0.65 ± 0.0	0.42 ± 0.02	0.28 ± 0.01	0.33 ± 0.04
27	10.82 ± 0.01	1.51 ± 0.02	2.67 ± 0.0	72.7 ± 0.01	10.6 ± 0.01	0.5 ± 0.0	0.42 ± 0.0	0.28 ± 0.0	0.36 ± 0.0
28	10.55 ± 0.02	1.46 ± 0.0	2.77 ± 0.04	71.86 ± 0.01	11.68 ± 0.01	0.56 ± 0.01	0.38 ± 0.0	0.27 ± 0.0	0.34 ± 0.02
29	9.41 ± 0.03	2.08 ± 0.0	2.57 ± 0.01	73.21 ± 0.02	11.01 ± 0.01	0.38 ± 0.0	0.32 ± 0.0	0.26 ± 0.0	0.62 ± 0.01
30	13.57 ± 0.01	4.41 ± 0.0	1.42 ± 0.01	68.46 ± 0.02	10.58 ± 0	0.7 ± 0.0	0.29 ± 0.01	0.23 ± 0.0	0.18 ± 0.0
31	17.55 ± 0.03	8.08 ± 0.01	0.6 ± 0.0	60.95 ± 0.04	11.52 ± 0.01	0.86 ± 0.0	0.12 ± 0.0	0.18 ± 0.0	ND
32	10.79 ± 0.04	0.7 ± 0.0	3.12 ± 0.03	74.32 ± 0.06	9.28 ± 0.01	0.66 ± 0.0	0.48 ± 0.0	0.3 ± 0.0	0.22 ± 0.0
33	11.7 ± 0.01	0.9 ± 0.0	2.93 ± 0.0	72.11 ± 0.01	10.58 ± 0	0.65 ± 0.0	0.48 ± 0.0	0.3 ± 0.0	0.23 ± 0.01
34	16.92 ± 0.04	5.68 ± 0.0	1.36 ± 0.03	61.79 ± 0.05	12.78 ± 0.01	0.82 ± 0.0	0.24 ± 0.0	0.2 ± 0.0	0.09 ± 0.01
35	16.87 ± 0.02	5.77 ± 0.0	1.32 ± 0.03	61.7 ± 0.05	12.89 ± 0.01	0.82 ± 0.0	0.23 ± 0.0	0.19 ± 0.0	0.08 ± 0.0
36	20.95 ± 0.01	10.21 ± 0.01	0.75 ± 0.01	52.31 ± 0.01	14.28 ± 0.0	0.95 ± 0.0	0.13 ± 0.0	0.19 ± 0.0	0.12 ± 0.02

often only used if fatty acid profile data comes up inconclusive and another method is needed to determine purity. However, the most effective way to determine purity is to use both sterols and fatty acid profile. Table 3 shows the sterols for the oils in this study Table 4 summarizes all the data from this study as well as listing which samples passed/failed the purity standards. There were ten refined oils that passed the new sterols parameters (including sample 12). The CODEX standards were recently amended for the stigmastanol lower limit to be 0.3 instead of ND, however, Green and Wang (2023a) demonstrated that many pure oils can have ND levels of stigmastanol. Sample 12 passed all fatty acid purity parameters as well as all sterols except it has an ND level of stigmastanol. Considering the previous research on pure avocado oil, this sample was listed as passing. All of the virgin/extra virgin oils passed the sterols parameters except for 32 and 33, which had low campesterol. These two samples also had several fatty acids out of range, indicating EMA is occurring and a high adulteration percentage is likely. Three samples (6, 7 and 13) had an elevated level of brassicasterol, which is a known canola oil indicator. Given the similarity of the sterols and fatty acid profiles in these three samples it is possible that they originated from the same supplier who committed to EMA. It is worth noting that these three samples had fatty acids that were either within the acceptable range or only slightly outside the proposed limits so if only fatty acids, without sterols, was used to check purity, these adulterated samples may have passed as pure avocado oil.

Known adulterants of avocado oil are high oleic safflower and high oleic sunflower oil, and although their chemical compositions can vary, adulteration with these oils is often characterized by an elevated stearic fatty acid level and an elevated delta-7-stigmastanol value and possible delta-7-avenasterol value (Codex Alimentarius Commission, 2021b).

These sterols trends were also seen in the confirmed adulterated samples from the first market analysis study in 2020 (Green & Wang, 2020). Although many samples passed the proposed sterols parameters, there is still a debate on the appropriate limit for the delta-7 sterols. Based on the results from Green and Wang (2023a), it is possible the 3.5 limit is too high, and CODEX should consider adopting the lower 1.5 limit that was also proposed. In this study all of the samples (1, 15, 17, 25, and 28) that had a delta-7-stigmastanol level over 2.5%, also did not pass the stearic fatty acid content (high) and had a palmitoleic content that was too low, indicating there is a high probability these samples are adulterated.

There are other samples (20, 21, 30, and 34) that had an elevated stearic fatty acid value without also having high delta-7-content and passed all the remaining fatty acid profile parameters, as well as the sterols parameters. All four of these samples had palmitoleic content on the lower end, with 20, 21 and 30 at or below 5.0%. Cases like this are still difficult to determine as adulteration with high oleic safflower or high oleic sunflower oils can lead to this type of fatty acid and sterols profile. Adulteration is often accompanied with higher levels of the delta-7 sterols, and if this were the case, it would be much more likely. However, according to the CODEX parameters pure high oleic safflower and sunflower oils can have non-detectable amounts of both delta-7 sterols (Codex Alimentarius Commission, 2021b). Therefore, it is still possible that adulteration is going on albeit, much more difficult to confirm. It is imperative that further studies are done to understand if refining can contribute to elevated delta-7 sterols and stearic fatty acid, and if so, investigate other ways to detect adulteration in avocado oil, as differentiating it between high oleic safflower and high oleic sunflower oils is difficult.



**Table 3**

Detailed sterols results reported as percent of total sterols. The proposed CODEX standards as of 2021 are listed above the samples Sterols are abbreviated and end in -sterol, with the exception of delta-7-stigmastenol. Any value in red does not fit within these current CODEX ranges.

Code	Brassica	Campe	Stigma	Clero	B-sito	Delta-5-avena	Delta-7-stigma	Delta-7-avena
CODEX 2021 Stds	ND-0.5	4.0-8.3	0.3-2.0	1.0-2.0	79.0-93.4	2.0-8.0	ND-3.5	ND-1.5
1	ND	7.57 ± 0.00	2.64 ± 0.30	1.4 ± 0.0	78.92 ± 0.01	4.94 ± 0.1.0	3.38 ± 0.12	1.15 ± 0.09
2	ND	8.74 ± 0.16	2.61 ± 0.15	0.95 ± 0.02	75.1 ± 1.81	5.49 ± 0.38	5.79 ± 1.64	1.33 ± 0.10
3	ND	8.34 ± 0.01	3.74 ± 0.13	0.87 ± 0.03	75.96 ± 0.06	4.53 ± 0.1.0	4.85 ± 0.00	1.71 ± 0.14
4	ND	8.31 ± 0.05	1.73 ± 0.22	1.27 ± 0.14	81.42 ± 0.69	6.55 ± 0.18	0.37 ± 0.18	0.36 ± 0.03
5	ND	8.26 ± 0.29	1.74 ± 0.06	1.34 ± 0.16	80.81 ± 1.23	6.82 ± 0.34	0.58 ± 0.29	0.45 ± 0.09
6	2.10 ± 0.04	15.68 ± 0.14	2.05 ± 0.21	1.06 ± 0.08	72.77 ± 0.55	5.38 ± 0.41	0.65 ± 0.12	0.3 ± 0.06
7	2.33 ± 0.14	16.32 ± 0.48	2.09 ± 0.28	1.02 ± 0.33	69.39 ± 1.39	6.31 ± 0.38	1.7 ± 0.42	0.83 ± 0.32
8	ND	5.85 ± 0.04	0.56 ± 0.03	1.86 ± 0.25	89.62 ± 0.4	2.11 ± 0.08	ND	ND
9	ND	5.96 ± 0.14	0.61 ± 0.09	1.73 ± 0.09	89.6 ± 0.36	2.10 ± 0.04	ND	ND
10	ND	10.64 ± 0.18	3.0 ± 0.01	1.13 ± 0.16	77.41 ± 0.25	5.57 ± 0.31	1.56 ± 0.05	0.69 ± 0.01
11	ND	6.95 ± 0.05	0.47 ± 0.20	1.45 ± 0.13	85.73 ± 1.14	5.40 ± 1.12	ND	ND
12	ND	6.58 ± 0.01	ND	1.42 ± 0.04	87.07 ± 0.14	4.92 ± 0.09	ND	ND
13	2.07 ± 0.19	16.1 ± 0.26	1.94 ± 0.25	1.16 ± 0.06	70.52 ± 0.81	5.85 ± 0.03	1.63 ± 0.27	0.72 ± 0.28
14	ND	9.86 ± 0.07	2.49 ± 0.09	1.15 ± 0.04	79.48 ± 0.15	6.41 ± 0.02	0.33 ± 0.07	0.29 ± 0.00
15	ND	4.62 ± 0.04	1.73 ± 0.03	0.87 ± 0.04	83.72 ± 0.21	5.05 ± 0.14	2.63 ± 0.15	1.39 ± 0.20
16	ND	4.81 ± 0.05	1.81 ± 0.13	0.94 ± 0.06	82.49 ± 0.62	4.82 ± 0.13	3.96 ± 0.19	1.16 ± 0.32
17	ND	6.44 ± 0.01	3.46 ± 0.27	1.57 ± 0.51	79.61 ± 0.72	4.41 ± 0.08	3.36 ± 0.18	1.15 ± 0.14
18	ND	4.92 ± 0.04	2.57 ± 0.37	0.88 ± 0.20	82.42 ± 0.63	3.84 ± 0.15	4.28 ± 0.08	1.09 ± 0.34
19	ND	8.06 ± 0.08	1.67 ± 0.16	1.23 ± 0.08	83.05 ± 0.49	5.32 ± 0.30	0.38 ± 0.17	0.29 ± 0.03
20	ND	6.92 ± 0.05	0.68 ± 0.02	1.57 ± 0.12	84.12 ± 0.28	6.06 ± 0.25	0.33 ± 0.13	0.33 ± 0.06
21	ND	6.89 ± 0.10	0.69 ± 0.03	1.38 ± 0.04	84.52 ± 0.24	6.01 ± 0.31	0.21 ± 0.07	0.29 ± 0.02
22	ND	5.73 ± 0.02	1.28 ± 0.16	1.26 ± 0.24	83.46 ± 0.97	5.54 ± 0.51	1.98 ± 0.18	0.75 ± 0.26
23	ND	8.06 ± 0.09	3.83 ± 0.40	1.20 ± 0.35	75.05 ± 1.21	4.03 ± 0.20	5.99 ± 0.44	1.83 ± 0.43
24	ND	5.51 ± 0.01	3.56 ± 0.46	0.76 ± 0.14	78.99 ± 0.46	3.36 ± 0.24	6.34 ± 0.06	1.48 ± 0.17
25	ND	6.39 ± 0.04	2.09 ± 0.15	1.23 ± 0.22	80.62 ± 0.80	5.84 ± 0.35	2.87 ± 0.30	0.96 ± 0.18
26	ND	7.19 ± 0.04	3.41 ± 0.38	0.85 ± 0.04	75.55 ± 0.71	5.45 ± 1.36	5.62 ± 0.17	1.94 ± 0.52
27	ND	7.21 ± 0.40	3.12 ± 0.54	0.80 ± 0.08	76.52 ± 2.97	5.28 ± 0.89	5.34 ± 1.29	1.72 ± 0.56
28	ND	5.29 ± 0.03	2.93 ± 0.21	0.72 ± 0.13	81.98 ± 1.54	4.6 ± 0.24	3.27 ± 0.61	1.21 ± 0.32
29	ND	8.66 ± 0.05	6.33 ± 0.32	0.99 ± 0.31	66.58 ± 2.82	4.11 ± 0.27	9.69 ± 2.16	3.65 ± 0.96
30	ND	5.9 ± 0.03	1.70 ± 0.42	1.45 ± 0.13	82.29 ± 1.41	5.93 ± 0.38	1.94 ± 0.18	0.79 ± 0.33
31	ND	6.11 ± 0.05	0.46 ± 0.27	1.82 ± 0.13	85.39 ± 0.78	6.21 ± 0.33	ND	ND
32	ND	3.48 ± 0.05	1.74 ± 0.31	0.96 ± 0.12	87.44 ± 0.06	5.51 ± 0.27	0.58 ± 0.15	0.29 ± 0.03
33	ND	3.27 ± 0.07	1.40 ± 0.24	1.49 ± 0.20	87.11 ± 0.21	6.10 ± 0.22	0.37 ± 0.05	0.24 ± 0.08
34	ND	6.08 ± 0.02	0.33 ± 0.18	1.76 ± 0.01	83.89 ± 0.07	7.94 ± 0.07	ND	ND
35	ND	6.05 ± 0.01	0.60 ± 0.42	1.65 ± 0.04	84.29 ± 0.68	7.41 ± 0.22	ND	ND
36	ND	7.84 ± 0.07	0.76 ± 0.14	2.09 ± 0.25	83.89 ± 0.27	5.42 ± 0.06	ND	ND

### 3.1.3. Triacylglycerol analysis

Triacylglycerols, TAGs, can also be used to determine avocado oil purity. Fig. 1 shows two of the sample sets discussed in section 3.1.2 on the TAG/PCA plot that was previously developed in the Green and Wang (2023b). The first group of samples (1, 15, 17, 25, and 28) had an elevated C18:0, low C16:1, but a delta-7 stigmastenol content under the current 3.5% standard, but still was over our proposed upper limit of 2.5%. All of these samples are outside of the avocado oil cluster and are located in the bottom left quadrant along with the pure high oleic safflower and high oleic sunflower clusters, indicating that they are adulterated with high amounts of either of these two oils. This also further confirms that samples with high amounts of delta-7 stigmastenol are more likely to be adulterated with high oleic safflower and sunflower oils. The TAGs can also be useful when the purity of samples is unclear from fatty acids and sterols analysis, like in the cases of 20, 21, 30, and 34, these four ambiguous samples, which passed all purity parameters except a slightly elevated stearic fatty acid value show different results. Sample 34 is right on the edge of the 95% confidence ellipse in the avocado cluster, indicating that this sample is likely pure. Compared to the other three oils in this group, it had a higher palmitoleic content, which is more consistent with a pure avocado oil. Samples 20, 21, and 30 are further away and there is a higher chance they could be adulterated with a smaller amount high oleic sunflower or high oleic safflower oil. The avocado oil cluster used in this plot does have some limitations, it was created using samples from California and Mexico and does not include refined oils, however, samples 20, 21, and 30 were stated to originate from Mexico (Table 1). Other factors, such as oil quality and cost, that professional buyers can consider when choosing an oil are discussed below in sections 3.2 and 3.3, respectively.

### 3.2. Quality parameters

Although there has been significant progress to adopting a set of avocado oil standards, the primary focus of these efforts has been on oil purity to combat EMA, as this is the biggest risk to both consumer health and genuine producers in the industry. Oil quality has not been a priority for the industry or standard development agencies and work still needs to be done to differentiate what the limits should be for refined avocado oil and extra virgin avocado oil. Therefore, this study used the extra virgin limits proposed in the Green and Wang (2022a) oil quality study, which were built off the work done by Woolf et al. (2009). Because that study did not analyze refined oils, those limits will be based off Woolf et al. (2009) and standards proposed by CODEX in 2019.

#### 3.2.1. Free fatty acid analysis

Free fatty acids in the oil are an indicator of using poor quality fruit to make oil, which can happen on or off the tree for example, using overripe fruits (Green & Wang, 2022a), fruits with insect bites or improper handling/excessive heat in processing (Woolf et al., 2009). This can result in the fatty acids separating from the triacylglycerol, compound that makes up oil, and becoming “free” in the oil. The free fatty acid content is displayed in Fig. 2a. With Tables 4 and 5 summarizing the number of samples that passed purity and quality data. Proposed CODEX standards from 2019, as well as Woolf et al. (2009), suggested that refined avocado oil should have values that are less than 0.1%. Most refined oils in this study met this proposed standard, with only four of the 29 refined samples not passing and, only one of those four samples (number 22) was likely to be pure avocado oil. The extra virgin oils have a higher FFA than refined oils, which is expected since

**Table 4**

Summary of quality and purity parameters. Values highlighted in blue do not pass *extra virgin* avocado oil standards and those highlighted in red do not pass the *refined* oil standards. Refined oil standards are from the CODEX proposal; extra virgin oil standards FFA and PV are from [Green et al. \(2020\)](#) and delta K from the IOC (CODEX does not currently have EV proposed standards).

Sample Code	Label descriptors	Product origin	FFA (% oleic acid)	PV (meq O <sub>2</sub> /kg)	UV: Delta K (ΔK)	Fatty acid profile	Sterols profiles
Refined Standards <sup>a</sup>			≤0.1	≤2.0	N/A		
EV Standards <sup>a</sup>			≤0.8	≤10.0	≤0.01		
1	Refined	Mexico	0.19 ± 0.01	2.09 ± 0.14	0.04 ± 0.00	Fail	Fail
2	Refined	Mexico	0.25 ± 0.01	2.18 ± 0.28	0.05 ± 0.00	Fail	Fail
3	Refined	Spain	0.13 ± 0.00	3.97 ± 0.01	0.04 ± 0.00	Fail	Fail
4	Refined	USA, Mexico	0.07 ± 0.00	3.08 ± 0.15	0.07 ± 0.00	Pass	Pass
5	Refined	USA, Mexico	0.08 ± 0.00	3.47 ± 0.15	0.06 ± 0.00	Pass	Pass
6	Refined	Mexico, South Africa, France	0.09 ± 0.00	1.79 ± 0.00	0.06 ± 0.00	Fail	Fail
7	Refined	Mexico, South Africa, France	0.10 ± 0.00	1.09 ± 0.14	0.06 ± 0.00	Fail	Fail
8	Refined & expeller pressed	France	0.04 ± 0.00	1.00 ± 0.00	0.01 ± 0.01	Pass	Pass
9	Refined & expeller pressed	France	0.03 ± 0.00	1.09 ± 0.14	0.00 ± 0.00	Pass	Pass
10	Refined & expeller pressed	Mexico	0.09 ± 0.01	2.18 ± 0.02	0.05 ± 0.00	Pass	Fail
11	Refined & expeller pressed	South Africa	0.08 ± 0.00	6.05 ± 0.13	0.01 ± 0.00	Pass	Pass
12	Refined & expeller pressed	South Africa	0.09 ± 0.00	6.67 ± 0.17	0.01 ± 0.00	Pass	Pass <sup>b</sup>
13	Refined & expeller pressed	Mexico	0.10 ± 0.01	3.08 ± 0.16	0.05 ± 0.00	Fail	Fail
14	Refined & expeller pressed	Mexico	0.06 ± 0.00	3.17 ± 0.00	0.08 ± 0.00	Fail	Fail
15	Refined & cold pressed	Spain	0.13 ± 0.00	3.08 ± 0.43	0.05 ± 0.00	Fail	Fail
16	Refined & cold pressed	Spain	0.13 ± 0.00	4.28 ± 0.43	0.07 ± 0.02	Fail	Fail
17	Refined & cold pressed	Mexico, Spain, USA	0.11 ± 0.00	0.7 ± 0.14	0.05 ± 0.00	Fail	Fail
18	Refined & cold pressed	Mexico, Spain, USA	0.13 ± 0.01	1.79 ± 0.00	0.06 ± 0.00	Fail	Fail
19	Unspecified	Mexico	0.11 ± 0.01	1.78 ± 0.28	0.03 ± 0.00	Pass	Pass
20	Unspecified	Mexico	0.10 ± 0.00	4.58 ± 0.01	0.05 ± 0.00	Fail	Pass
21	Unspecified	Mexico	0.09 ± 0.00	4.27 ± 0.14	0.05 ± 0.00	Fail	Pass
22	Unspecified	Mexico	0.17 ± 0.01	2.08 ± 0.14	0.02 ± 0.00	Pass	Pass
23	Unspecified	Mexico	0.15 ± 0.01	2.29 ± 0.14	0.04 ± 0.00	Fail	Fail
24	Unspecified	Mexico	0.10 ± 0.00	0.79 ± 0.0	0.09 ± 0.00	Fail	Fail
25	Unspecified	Mexico	0.14 ± 0.00	4.28 ± 0.42	0.08 ± 0.00	Fail	Pass
26	Cold pressed	Spain	0.13 ± 0.00	1.49 ± 0.15	0.04 ± 0.00	Fail	Fail
27	Cold pressed	Mexico, Spain, USA	0.13 ± 0.00	1.19 ± 0.00	0.04 ± 0.00	Fail	Fail
28	Cold pressed	Mexico, Spain, USA	0.12 ± 0.00	2.78 ± 0.00	0.05 ± 0.00	Fail	Fail
29	Cold pressed	Mexico, Spain, USA	0.09 ± 0.00	0.8 ± 0.00	0.07 ± 0.00	Fail	Fail
30	Virgin/Extra virgin	Mexico	0.76 ± 0.01	5.28 ± 0.15	0.03 ± 0.00	Fail	Pass
31	Extra Virgin	Mexico	1.71 ± 0.00	3.28 ± 0.43	0.00 ± 0.00	Pass	Pass
32	Extra virgin	Spain	0.12 ± 0.00	3.57 ± 0.27	0.05 ± 0.00	Fail	Fail
33	Extra virgin	Spain	0.12 ± 0.00	3.98 ± 0.01	0.06 ± 0.00	Fail	Fail
34	Virgin	Mexico	0.73 ± 0.01	8.77 ± 0.01	0.01 ± 0.00	Fail	Pass
35	Virgin	Mexico	0.73 ± 0.01	8.66 ± 0.72	0.01 ± 0.00	Pass	Pass
36	Extra virgin	Mexico	1.39 ± 0.00	4.67 ± 0.70	0.01 ± 0.00	Pass	Pass

<sup>a</sup> Samples were considered passing if, when accounting for their standard deviation, they would fit into the proposed standards.

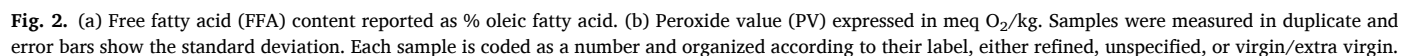
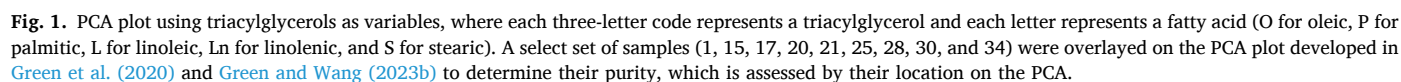
<sup>b</sup> This sample would fail if the current CODEX standards were accepted due to ND levels of stigmaterol, however, research has shown that pure oils often have ND levels of this sterol. Due to this being the only value out of range we believe it is pure, and thus was considered passing.

the refining process removes free fatty acids from the oil. Based on results from [Green and Wang \(2022a\)](#), it was recommended that the avocado oil extra virgin limit be raised to 0.8% from Woolf's original 0.5% limit. Using 0.8%, two extra virgin oils were outside the range, 31 and 36; however, these two oils were confidently confirmed as pure. The two extra virgin oils with the lowest FFA, 32 and 33, may look to be the best quality, however, they are not 100% avocado oil and failed both fatty acid and sterols profile purity analyses ([Table 4](#)). The low FFA indicates they are also possibly refined, which is discussed in the UV absorbance section [3.2.3](#).

### 3.2.2. Peroxide value

Peroxide value measures the oxidation in oil in the form of peroxides, which can be created via photooxidation, autooxidation, and thermal oxidation, and oxygen exposure over time, such as opening the bottle. [Woolf et al. \(2009\)](#) proposed 0.5 meq O<sub>2</sub>/kg to be the upper limit for PV

for refined avocado oils and standards proposed by Mexico for CODEX in 2019 suggested a limit 2.0 meq O<sub>2</sub>/kg for refined oils. The peroxide values are shown in [Fig. 2b](#). Taking the more lenient limit of 2.0 meq O<sub>2</sub>/kg, there were 15 refined oils that did not pass. [Table 1](#) shows there was not a correlation with PV and the type of storage container used, as clear bottles can increase the chance of photooxidation. In addition, all these oils were analyzed well before their best by dates, however, excessive heat or light exposure during sample transportation and storage may have increased the rate of peroxide production. The refining process removes peroxides; therefore, virgin/extra virgin oils have higher PV limits. Our study from 2022 ([Green & Wang, 2022a](#)) demonstrated that a PV limit of 10.0 meq O<sub>2</sub>/kg is appropriate and attainable for virgin/extra virgin avocado oils. [Table 4](#) shows that all of the virgin/extra virgin samples met our proposed PV limit of less than or equal to 10.0 meq O<sub>2</sub>/kg.



**Table 5**

Summary of total samples passing or failing standards. This table does not account for tocopherol data, as it is a minor component that is not an official quality or purity parameter.

	Number of samples	Samples met quality (FFA and PV) proposed standards <sup>a</sup>	Samples met purity (fatty acid and sterol profiles) proposed standards	Samples met both quality and purity proposed standards
Refined/Unspecified/Ambiguous	29	11	8	3
Virgin/Extra Virgin	7	2 <sup>b</sup>	3	1
Total	36	13	11	4

<sup>a</sup> It was assumed that any sample not explicitly labeled EV/V was refined.

<sup>b</sup> Samples 30, 32 and 33 were excluded as the UV data showed they contained refined oil and therefore not virgin/extra virgin.

### 3.2.3. UV absorbance

Another way to measure oil oxidation is through measuring the UV absorbances, measuring at a wavelength of 232 nm ( $K_{232}$ ) detects peroxides, like the peroxide value, however, it can also detect a wider variety of primary oxidation products. Secondary oxidation products are measured at a wavelength 270 nm ( $K_{270}$ ), which are often formed in high heat and thus values tend to be higher for refined oils. The delta K value is a unitless number calculated through the comparison of other UV absorbances, which was developed to detect the presence of refined oil if the value is over 0.01 (Vossen, 2007). The specific extinction in UV data is shown in Fig. 3. All of the  $K_{232}$  values are comparable across refined and virgin/virgin samples. However, there is a visible trend where samples with a low  $K_{270}$ , often also have a low delta K value. From this data, as expected from the FFA results, samples 32 and 33 are not virgin/extra virgin as they contained refined oil. However, these samples also had the highest price of the virgin/extra virgin oils at 0.83 cents/oz, which shows that a high price cannot be used as an indicator for good quality or purity. Interestingly, sample 36 was also 0.83 cents/oz however this sample is pure and unrefined (although its elevated FFA brings it below extra virgin quality). Sample 30 has values in between many of the refined and virgin/extra virgin samples and it is possible that it is a blend between the two and mislabeled as virgin/extra virgin. This sample also looked to be adulterated with a portion of high oleic safflower of high oleic sunflower oil (Fig. 1) the adulterant oil was likely refined and the source of the quality results.

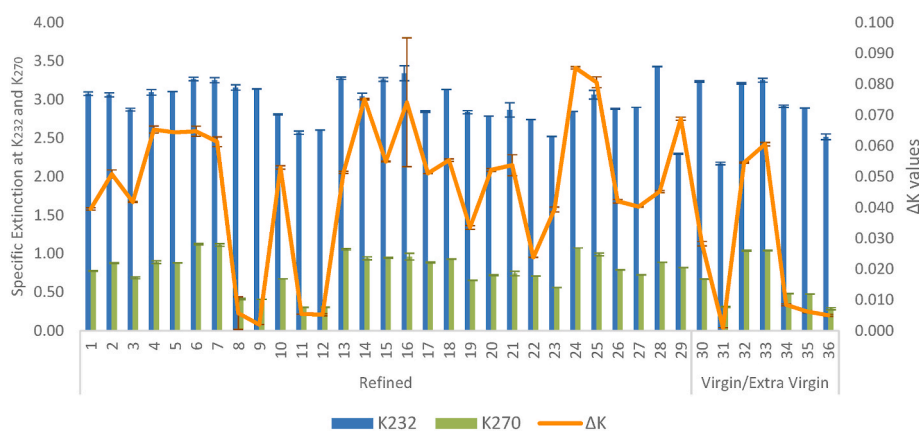
These results also demonstrate the ambiguity and discrepancies in the current labeling of avocado oils. A cold pressed oil is one that is inherently unrefined, it is obtained mechanically without the use of excessive heat or solvent (Codex Alimentarius Commission, 2021b). These oils are expected to be of virgin/extra virgin quality. Table 1 shows there are two sets of samples labeled either refined & cold pressed (15–18), a contradictory label, or only cold pressed (26–29) but without a virgin/extra virgin quality label. Both sets of samples have a delta K values significantly over 0.01 and thus have likely undergone refining.

They were also light in color and had low FFA values compared to the virgin/extra virgin oils, which supports our interpretation of these oils being refined as the refining process removes free fatty acids and the natural green color of avocado oil.

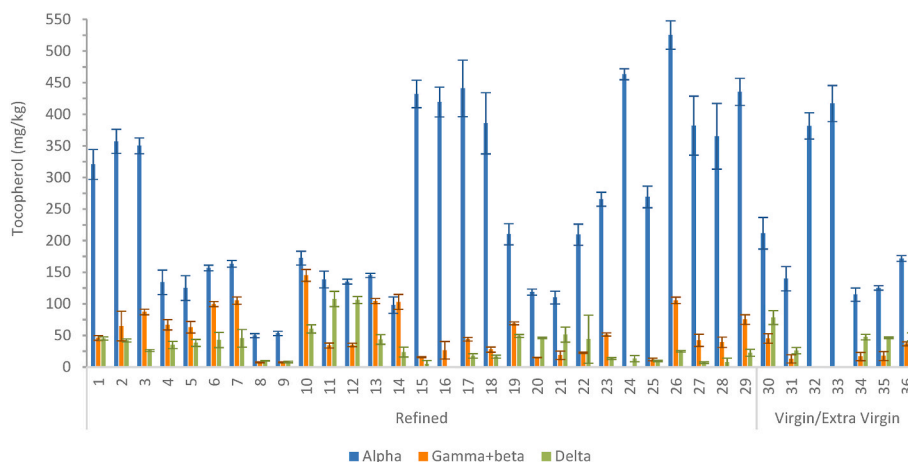
There are currently no proposed avocado oil standards for the specific extinction values or delta K, however, they were included in this study due to their utility to detect presence of refined oil. All values can be determined at once with minimal sample preparation, oil dilution. It also eliminates the inherent user bias associated with performing the titration for peroxide value.

### 3.3. Minor components

Tocopherols are not currently used as a purity parameter; however, they help makeup the vitamin E content in oils, along with tocotrienols. The CODEX standards for tocopherols are in the newer stages of development and were analyzed here to help gain an understanding of what the tocopherol content looks like in market avocado oils. Tocopherols are often removed in the refining process and then added back in, so the profiles of the refined oils do not necessarily represent the tocopherols naturally present in avocado oil and these differences need to be specified in standards. The tocopherol content is shown graphically in Fig. 4 and listed in Table S2. All of the extra virgin oils except the two that were known to be refined oils had tocopherol profiles within the new proposed standards. Interestingly, the majority of the refined oils also had tocopherols that were within the limits, except for the samples that had “refined and cold-pressed” or “cold-pressed” on the label, all of which had higher amounts of alpha tocopherols than expected. The refining process still removes tocopherols even if the oil was cold pressed before refining. Thus, it is most likely that tocopherols were added in at higher concentrations after refining for these samples, rather than the processing impacting the tocopherol content. Although CODEX is considering to add tocopherol profiles to standards, it should be noted that although tocopherols can be used to gain more information about



**Fig. 3.** Values for the primary oxidation products ( $K_{232}$ ) and secondary oxidation products ( $K_{270}$ ) shown on the left axis and the refining indicator,  $\Delta K$  on the right. Samples were measured in duplicate and error bars show the standard deviation. Each sample is coded as a number and organized according to their label, either refined, unspecified, or virgin/extra virgin.



**Fig. 4.** Samples were measured in triplicate and error bars show the standard deviation. Each sample is coded as a number and organized according to their label, either refined, unspecified, or virgin/extra virgin.

an oil, they are not reliable compounds to use to determine oil authenticity. Because they can be removed in refining and then added back in afterwards, this could allow for tocopherols to be spiked into the oil to make it appear as if it fits within the avocado oil standards, even if the oil is not authentic.

### 3.4. Information for professional buyers

Table 5 summarizes the results from this study, including the number of samples that passed purity and quality parameters. Although these numbers seem discouraging, as only three refined samples and one virgin/extra virgin sample passed both purity and quality standards, this study identified trends in adulterated samples so that professional buyers can use this information to make more educated choices on their suppliers, which are listed in Table 6. If there is a slightly elevated stearic acid value accompanied by a slightly elevated delta-7-stigmastenol and delta-7-avenasterol then adulteration with a seed oil, primarily sunflower or safflower oil is likely. Furthermore, most adulterant oils have low palmitoleic fatty acid content so if the previously

mentioned trends are seen in addition to a palmitoleic content that is on the bottom end of the range, or just outside of standard range this can also be used as an adulteration indicator. If oleic acid content is high while the previous trends are seen then the adulteration is likely to be specifically with high oleic safflower or high oleic sunflower oil, rather than with canola or soybean oil. If there is an elevated brassicasterol value, then adulteration with canola oil is likely, especially when it is accompanied by a low palmitic acid. Also, generally, the greater the number of fatty acids and sterols that do not pass and the more significantly that each is out of range, the more likely that EMA is occurring.

In terms of ensuring oil quality, virgin/extra virgin oils should be green in color and have some mild flavors. Refined oils range from yellow to clear in color and are free of flavors. In addition, they should ensure that the label of the oil being advertised to them does not contain discrepancies and matches the product; an oil cannot be both refined (or expeller pressed) and cold pressed. A virgin/extra virgin oil should not have undergone refining and thus the color would be expected to be green instead of yellow to clear. Professional buyers should avoid products that have common sensory defects such as rancidity which are markers for oxidation and shorten shelf life. To ensure the oil is free of rancidity, it is advisable to test oil quality not only at the point of production but throughout the time before best-by date. An oil with high FFA tested after production will have shorter shelf life than an oil with low FFA as free fatty acids can accelerate oxidation.

Prices are a top concern for professional buyers, as it is for consumers, in addition to the product quality and safety. The average cost for the refined samples from this study was 0.53 cents/oz and of the samples that failed both fatty acids, sterols and were clearly adulterated according to the TAGs/PCA, the price averaged 0.40 cents/oz. The six cheapest refined samples, which were all under 0.40 cents/oz, were all in the set of samples that failed both fatty acids, sterols and TAGs/PCA. Thus, always trying to buy the lowest-cost oil increases risk of purchasing an adulterated product. However, even though low cost can indicate a higher probability for adulteration, high cost does not guarantee a pure sample of appropriate quality. Not only were samples 32 and 33 not virgin/extra virgin, as labeled, but they were also highly adulterated with refined oil that is cheaper than avocado oil. However, they were two of the most expensive samples in this study and of the virgin/extra virgin oils at 0.83 cents/oz compared to the 0.74 cents/oz average for the other virgin/extra virgin oils. This is a crucial finding, and it demonstrates to professional buyers that high cost does not ensure an unadulterated, high-quality product. The two most expensive refined samples (4 and 5) were determined to be pure, however they were oxidized. It is possible that, because the higher prices, these two samples have been in the warehouse or store shelf for some time and oxidation

**Table 6**  
Indicative fatty acids and sterols of common adulterants detected in avocado oil, HO = high oleic.

		Change in concentration	Potential adulterant (oil)
Key fatty acid	Palmitic acid (16:0)	Increase	HO safflower, HO sunflower, canola
	Palmitoleic acid (16:1)	Decrease	HO safflower, HO sunflower, soybean, canola
	Stearic acid (18:0)	Increase	HO safflower, HO sunflower, soybean
	Oleic acid (18:1)	Decrease	Soybean
	Linoleic acid (18:2)	Increase	Soybean, canola
	Linolenic acid (18:3)	Increase	Soybean, canola
Key sterols	Brassicasterol	Increase	Canola
	Campesterol	Increase	HO safflower, soybean, canola
	Stigmasterol	Increase	HO safflower, HO sunflower, soybean
	Beta-sitosterol	Decrease	HO safflower, HO sunflower, soybean, canola
	Delta-7-stigmastenol	Increase	HO safflower, HO sunflower, soybean
	Delta-7-avenasterol	Increase	HO safflower, HO sunflower, soybean



started to take place. On the other hand, samples 8, 9, and 19 were all pure and of good quality while being fairly average in price at 0.53 cents/oz for samples 8 and 9 and 0.44 cents/oz for sample 19. This shows that good quality, pure avocado oils do exist and can be purchased by professional buyers at a reasonable cost while also having confidence in the product.

We use the word “cold press” in this article to be consistent with the labels on the bottles of the oil we analyzed, however, “cold press” is an obsolete term that the industry should stay away from. In modern avocado oil processing facilities, virgin/extra virgin oil is made through centrifugation instead of the traditional press, thus the word “cold press” misinforms consumers about the avocado oil extraction process. In addition, avocado oil is a perishable item, and it should be treated as such with a disclosed best-before date and harvest date (for virgin/extra virgin). Declaration of product grade (virgin/extra virgin, refined, or a mixture of both) and the product origin should be accurate and clear. Professional buyers can request these product details such as product origin, harvest and post-harvest protocols, extraction/refining methods from a potential supplier as well as a Certificate of Analysis, ideally performed by an independent, third-party laboratory that includes purity and quality parameters outlined in this study. They can then compare the values to current standards (or proposed standards) and use the guide in Table 6 to make an educated decision on sample purity.

#### 4. Conclusions

This study demonstrates that although progress is being made in standard development since our first market study in 2020, there are still issues with purity in avocado oil and these issues extend significantly into private label oils. Out of 29 refined samples, three met both quality and purity standards and eight met current proposed purity standards (Table 5). Out of seven virgin/extra virgin samples, one met both quality and purity standards and three met current proposed purity standards. Although improvements need to be made, there are samples available that are pure, good quality, and available at a reasonable price. The best way to determine if an avocado oil is pure and of good quality is not with one specific method, but a combination of testing approaches including fatty acid profile, sterols profile, and the possible addition of TAGs for oil purity and using FFA and PV, with the potential of PV being replaced by UV, for oil quality. More research and coordinated efforts between industry, government agencies, and researchers are needed to establish enforceable standard so consumers can have confidence in the avocado oil products they purchase, and honest producers can make a living by competing in a fair market. With the popularity of avocado oil and the increasing number of private label brands, this work provides practical information to help professional buyers make educated decisions on what products to purchase to ensure that they are selling pure oils of appropriate quality.

#### CRediT authorship contribution statement

**Hilary S. Green:** Methodology, Software, Validation, Formal analysis, Data curation, Investigation, Writing – original draft, Writing – review & editing, Visualization, Funding acquisition. **Selina C. Wang:** Conceptualization, Methodology, Investigation, Resources, Supervision, Writing – review & editing, Project administration, Funding acquisition.

#### Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

#### Data availability

Data will be made available on request.

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#### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.foodcont.2023.109837>.

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# EXHIBIT 4



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## Food Control

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# First report on quality and purity evaluations of avocado oil sold in the US

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## ABSTRACT

The demand for avocado oil has increased significantly as consumers resonate with its potential health benefits, however, due to the lack of enforceable standards, consumers are unprotected from fraud (i.e., economic motivated adulteration). This study analyzed avocado oils currently on the market in the US to evaluate their quality (e.g., free fatty acidity, peroxide value, UV absorbances, vitamin E) and purity (e.g., fatty acids, sterols, triacylglycerols). Our results showed that the majority of commercial samples were oxidized before reaching the expiration date listed on the bottle. In addition, adulteration with soybean oil at levels near 100% was confirmed in two “extra virgin” and one “refined” sample. These findings demonstrate there is an urgent need to develop standards for avocado oil not only to ensure the consumers receive high quality and authentic products but to establish a level playing field to support the continuing growth of global avocado oil industry.

## 1. Introduction

The world's production of avocados increased one million tonnes from 2014 to 2017 and is projected to continue rising with Mexico accounting for one third of the world's production (Altendorf, 2019). Consumer demand for the fruit is largely due to the health benefits associated with avocados, which have high amounts of mono-unsaturated fatty acids and antioxidants (Fernandes, Gómez-Coca, Pérez-Camino, Moreda, & Barrera-Arellano, 2018; Wang et al., 2019; Wong, Requejo-Jackman, & Woolf, 2010). The rising popularity of avocados has also led to the rise in avocado products, namely avocado oil.

Competition in the market place for avocado oil continues with one major boundary, there are currently no standards to determine if an avocado oil is of the quality advertised and authentic. Oils that are of poor quality or blended with cheaper edible oil can be traded and sold at lower prices than high quality or authentic products leaving bulk buyers, food service professionals and consumers unprotected. With no standards available, there is no way to ensure avocado oil is safe. Standards developed for edible oils commonly fall into two categories, quality and purity. Quality can be controlled by the fruit used to make the oil, extraction process, storage; it's mostly related to level of hydrolysis of the fruit and oxidation of the oil (Woolf et al., 2009). An oil is considered pure or authentic if there are no other additives or oils present other than what is listed on the label.

So far, much of literature has focused on improving extraction

methods for avocado oil (Corzzini, Barros, Grimaldi, & Cabral, 2017; Dos Santos, Alicio, Pereira, Ramis-Ramos, & Mendonça, 2014; Krumreich, Borges, Mendonça, Jansen-Alves, & Zambiasi, 2018; Ortiz Moreno, Dorantes, Galíndez, & Guzmán, 2003; Ramírez-Anaya, Manzano-Hernández, Tapia-Campos, Alarcón-Domínguez, & Castañeda-Saucedo, 2018; Tan & Ghazali, 2019; Werman & Neeman, 1987). There have also been multiple studies chemically characterizing avocado oil based on cultivar (Fernandes et al., 2018; Manaf, Rahardjo, Yusof, Desa, & Nusantara, 2018; Yanty, Marikkar, & Long, 2011) and region (Donetti & Terry, 2014; Tan, Tan, & Tan, 2017). However, there is a need to understand the range in quality and purity of the avocado oils currently on the market and how chemical composition of these oils compare to avocado oils characterized in literature. A few studies have done this on a small scale (Fernandes et al., 2018; Flores, Perez-Camino, & Troca, 2014; Werman & Neeman, 1987), however, to our knowledge no study has comprehensively evaluated the quality and purity of avocado oils available in the US, which is one of the largest consuming countries in the world (Altendorf, 2019).

Here we present an analysis of the quality and purity of avocado oils available in the US market with the goal of starting a database to support standards development for this industry. Twenty-two samples were collected from six grocery stores (14 samples) and two online sources (eight samples), efforts were made to cover all the major brands and types of oil (extra virgin/unrefined and refined). Oil quality was determined using free fatty acidity (FFA), peroxide value (PV), and specific extinction in ultraviolet (UV) absorbances in addition to

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**Table 1**

Sample information for the oils used in this study.

Sample Code	Purchasing Method	Expiration Date (month-year)	Product Origin	Cost/fl oz (\$)	Packaging Type
EV1	Online	Oct-21	California	2.23	Dark glass
EV2	In store	Jun-21	California	1.29	Dark glass
EV3	In store	Feb-21	Mexico	0.65	Dark glass
EV4	In store	Sep-20	California	1.53	Dark glass
EV5	Online	Jul-21	California	1.57	Dark glass
EV6	Online	NA	Brazil	0.49	Clear plastic
EV7	Online	Jun-21	California	2.35	Dark glass
R1	Online	Jun-21	Spain or Mexico	0.44	Dark plastic
R2	In store	Aug-20	Mexico	0.74	Dark glass
R3	In store	Nov-20	Mexico	0.43	Dark glass
R4	Online	Dec-20	Mexico	0.35	Clear plastic
R5	In store	May-20	Mexico	0.25	Dark plastic
R6	In store	Jul-20	Mexico	0.77	Dark glass
R7	Online	Dec-19	Mexico	0.80	Dark glass
R8	In store	Apr-21	Mexico	1.44	Clear glass
R9	In store	Apr-21	Mexico, USA, or Spain	0.29	Clear plastic
U1	In store	NA	Mexico	0.29	Dark plastic
U2	In store	Apr-21	Mexico, USA, or Spain	0.66	Tin bottle
U3	In store	Mar-21	Mexico, USA, or Spain	0.71	Tin bottle
U4	In store	May-21	Mexico	0.47	Dark glass
U5	In store	Jun-21	Mexico	0.79	Dark glass
U6	Online	Feb-21	Mexico	0.34	Clear plastic

chlorophyll and tocopherol content. The authenticity of the oils was assessed using the fatty acids, sterols, and triacylglycerols (TAG) profiles. This study aimed to better understand the quality and purity of avocado oils available in the US and to demonstrate that there is an urgent need for standards in this industry.

## 2. Materials and methods

### 2.1. Avocado oil samples

A total of 22 avocado samples consisting of both extra virgin and refined oils were collected from six grocery stores (14 samples) and two online sources (eight samples). Each oil sample was wrapped in aluminum foil and stored in the dark at 20 °C. Samples were purged with nitrogen after each opening. Table 1 contains information such as purchasing method, expiration date, product origin, cost and packaging type for each oil. Samples were separated into three groups according to their label. Extra virgin oil was coded as “EV” in front of the sample number, refined avocado oil as “R”, and unspecified oils “U”. The unspecified oils were samples that either did not specify the type of avocado oil or, samples that had unclear and ambiguous labels on the bottle.

### 2.2. Quality parameters

FFA, PV, UV specific extinction at 232 nm, 270 nm, and ΔK were determined using AOCS methods Ca 5a-40 (09), Cd 8b-90 (09), and Ch 5–91 (09) (American Oil Chemist's Society, 1998), respectively.

### 2.3. Minor components

Chlorophylls were determined according to AOCS method Cc 13d-55 (09) (American Oil Chemist's Society, 1998). Tocopherols were determined according to Gimeno, Castellote, Lamuela-Raventós, de la Torre, and López-Sabater (2000) with some modifications. Oil (40 µL) and hexane (160 µL) were briefly vortexed. The internal standard, α-tocopheryl acetate (purity 98%, Fisher Scientific Company LLC, USA) in ethanol at a concentration of 300 µg/mL, was then added in addition to 600 µL of methanol. The sample was vortexed for 1 min and centrifuged (5000 rpm, 5 min, Beckman GS-15R). Samples were stored at –20 °C for 2 h to allow oil to separate from the organic phase. The organic extract was filtered (0.45 µm, nylon). Analysis was performed on an

Agilent 1290 Infinity II LC system with a diode-array detector using an Agilent ZORBAX Eclipse Plus C18 column (3.5 µm, 3 × 100 mm). The mobile phase was methanol:water (96:4), isocratic. A 20 µL injection volume and flow rate of 1.0 mL min<sup>–1</sup> were used giving a total run time was 12 min. DAD signal was recorded at 292 nm. All solvents used above were HPLC grade, from Fisher Scientific LLC, USA. Standards α-tocopherol (>96%), and α-tocopheryl acetate (98%) were purchased from Fisher Scientific LLC, USA. Analytical grade standards δ-tocopherol and γ-tocopherol were purchased from MilliporeSigma, USA.

### 2.4. Purity parameters

The IOC official method for the determination of the fatty acid methyl esters by gas chromatography (COI/T.20/Doc. No 33/Rev.1, 2017) was used for fatty acid profile analysis (International Olive Council, 2017). The GC-FID analysis was conducted on an Agilent 7890A GC (Agilent Technologies, USA). A 20 m × 180 µm × 0.20 µm DB-23 capillary column (Agilent Technologies, USA) was used to achieve the separation of individual fatty acids. The injection volume was 1.0 µL and helium, ultra-high purity, Airgas, USA was used as a carrier gas at a flow rate of 1 mL min<sup>–1</sup>. The injector temperature was held at 250 °C at a split ratio of 50. The GC oven program was initially held at 80 °C for 0.5 min; then ramped at 65 °C min<sup>–1</sup> to 175 °C, followed by a ramp of at 10 °C min<sup>–1</sup> to 185 °C, which was held for 0.5 min. The last ramp was at 7 °C min<sup>–1</sup> to 230 °C and held for 5 min, giving a total run time of 14.89 min. The FID temperature was 260 °C. The detector gas consisted of hydrogen, ultra-high purity, Praxair, USA (flow rate: 40 mL min<sup>–1</sup>), air, specialty grade zero air, Praxair, USA, (flow rate: 400 mL min<sup>–1</sup>), and helium, ultra-high purity, Airgas, USA make up gas (flow rate: 25 mL min<sup>–1</sup>). Peak identification was performed using a FAME C8–C22, certified reference material, TraceCERT, MilliporeSigma, USA.

The IOC official method for the determination of the composition and content of sterols (COI/T.20/Doc. No 30/Rev.1, 2013) was used with modifications (International Olive Council, 2013). The unsaponifiable fraction was prepared by drying 0.5 mL of internal standard 0.2% α-cholestanol, analytical grade standard, MilliporeSigma, USA, ethyl acetate solution under nitrogen before adding 50 mL of 2 mol L<sup>–1</sup> ethanolic potassium hydroxide, >85%, Fisher Scientific LLC, USA, to 5 g of the avocado oil sample. The mixture was heated to gentle boiling and kept under reflux for 20 min. The organic/aqueous mixture was extracted three times, 200 mL ethyl ether in total, washed with DI

water, dried with anhydrous sodium sulfate, >99%, Fisher Scientific LLC, USA, evaporated to dryness, and further dried in an oven. The sterols were separated from the other unsaponifiable fractions on a silica gel 60F<sub>254</sub>-coated aluminum-backed thin-layer chromatography (TLC) sheet (MilliporeSigma, USA) with hexane/ethyl ether (60:40, v/v). The sterols band was made visible by spraying the plate with 0.2% 2,7-dichlorofluorescein, ~90% (TLC), MilliporeSigma, USA, ethanolic solution and was then dissolved in 10 mL hot ethyl acetate and 30 mL ethyl ether and evaporated to dryness. All solvents used above were of HPLC grade from Fisher Scientific LLC, USA. Finally, 300 µL of the silylation reagent (pyridine, >99%, Fisher Scientific LLC, USA/hexamethyl disilazane, >99%, MilliporeSigma, USA/trimethylchlorosilane, >99%, MilliporeSigma, USA, 9:3:1, v/v/v) was added to prepare the trimethylsilyl ethers for GC injection. The GC-FID analysis was conducted on an Agilent 7890A GC (Agilent Technologies, USA). A 30 m × 0.25 mm × 0.25 µm DB-5 capillary column (Agilent Technologies, USA) was used with an injection volume of 1.0 µL and helium, ultra-high purity, Airgas, USA, as the carrier gas at a flow rate of 1.2 mL min<sup>-1</sup>. The injector temperature was held at 280 °C at a split ratio of 25. The GC oven program was held isothermally at 150 °C for 8 min; then ramped at 20 °C min<sup>-1</sup> to 290 °C and held for 20 min to obtain a total run time of 37.33 min. The FID temperature was 300 °C. The detector gas consisted of hydrogen, ultra-high purity, Praxair, USA (flow rate: 30 mL min<sup>-1</sup>), air, specialty grade zero air, Praxair, USA (flow rate: 400 mL min<sup>-1</sup>), and helium, ultra-high purity, Airgas, USA, make up gas (flow rate: 25 mL min<sup>-1</sup>). Peak identification was carried out with standards campesterol (65%), stigmasterol (95%), β-sitosterol (95%), each from MilliporeSigma, USA and by comparing the generated chromatograms against the sample chromatograms provided in the IOC official method and their relative retention times while the quantification was performed using the peak area and concentration of the internal standard.

TAGs were separated and analyzed using the method described in Green et al. (2020). In brief, each oil was diluted to a final concentrate of 1% with chloroform and then analyzed with the Vanquish™ Flex UHPLC-CAD system (Thermo Fisher Scientific, Waltham, MA, USA). Analytes were separated on a Thermo Scientific™ Accucore™ C18 column (100 mm × 2.1 mm; 2.6 µm). The injection volume was 1 µL and the flow rate was 0.5 mL min<sup>-1</sup>. Mobile phase A was acetonitrile and mobile phase B was isopropanol using the solvent gradient conditions: start, 10% B; 2 min, 10% B; 25 min, 40% B; 30 min, 60% B; 35 min, 90% B; 40 min, 50% B and 45 min 10% B. All solvents were HPLC grade from Fisher Scientific LLC, USA.

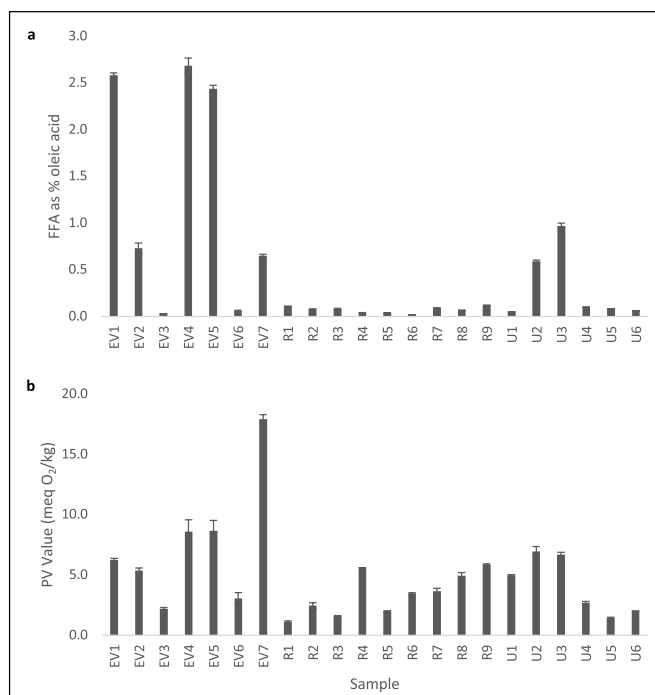
## 2.5. Statistical analysis

Statistical analysis was accomplished using Originlab Corporation software version “OriginPro 2016 Sr2.” This program was used to run PCA on all samples analyzed with the UHPLC-CAD. Principal component scores were computed by Originlab.

## 3. Results and discussion

### 3.1. Quality parameters

Free fatty acids in the oil are caused by lipolysis where the fatty acids are separated from the TAG and are commonly used as a measurement for oil quality (CODEX, 2017; Woolf et al., 2009). The free fatty acid content of the oils is summarized in Fig. 1a. Overall, samples labeled as “extra virgin” had higher free fatty acidity than “refined” which is expected as the refining processes remove free fatty acids. The unspecified avocado oils had similar values to the refined, aside from U2 and U3, which had an FFA of 0.59% and 0.97%, respectively. Woolf et al. (2009) proposed the refined avocado oil should have values that are less than 0.1% FFA while Wermer and Neman et al. (1987) saw about 0.55% FFA for refined oils (Wermer & Neeman, 1987; Woolf

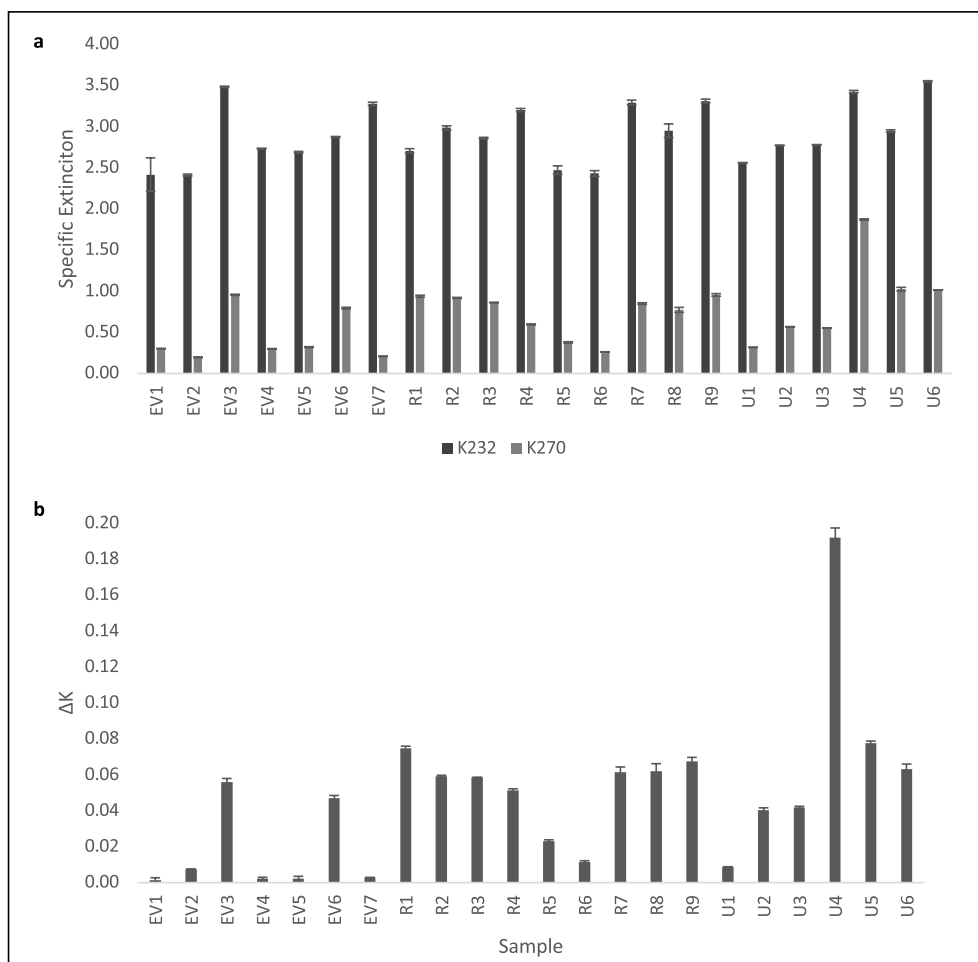


**Fig. 1.** (a) Free fatty acid content reported as % oleic fatty acid. (b) Peroxide value expressed in meq O<sub>2</sub>/kg. Each bar is an average of triplicate measurements and error bars are calculated using the standard error of the mean (SEM). EV stands for extra virgin, R for refined, and U for unspecified avocado oil.

et al., 2009). The refined oils in this study were all at or under 0.1%. Samples labeled as “extra virgin” had an FFA range of 0.03–2.69%, with an overall average of 1.31%. Commercial samples labeled as “virgin” analyzed in Flores et al. (2014) had FFA values ranging from 0.45 to 0.56%, while avocado oils made in-house in literature range from 0.12 to 2.84% (Bora, Narain, Rocha, & Queiroz Paulo, 2001; Krumreich et al., 2018; Manaf et al., 2018; Ortiz Moreno et al., 2003). The high values seen in this study could indicate use of poor-quality fruit and/or poor handling during processing, particularly for EV1, EV4 and EV5, which had values near 2.5%. Unhealthy fruits that are damaged, bruised, overripe, insect infested; prolonged time between harvest and processing; overheating during processing are all factors that can contribute to a rise in FFA (Woolf et al., 2009).

Peroxides are the primary oxidation products formed when an oil is exposed to oxygen and produce undesirable flavors and odors. The peroxide value results are shown in Fig. 1b. Although trends within the three sample groups are less obvious than with the FFA results, overall, the refined oils had the lowest PV values averaging at 3.42 meq O<sub>2</sub>/kg. The unspecified samples had a slightly higher average (4.13 meq O<sub>2</sub>/kg); extra virgin samples were the highest at 7.4 meq O<sub>2</sub>/kg. As with FFA, the refining process removes peroxides, therefore, lower values are expected for refined oils than those labeled extra virgin. However, many of the refined oils in this study still have notably high PV values. Woolf et al. (2009) proposed 0.5 meq O<sub>2</sub>/kg to be the upper limit for PV in refined avocado oils and standards proposed by Mexico for CODEX cap the acceptable PV at 2 meq O<sub>2</sub>/kg. All of the oils except for R1, R3, and R5 were above these limits (CODEX, 2017; Woolf et al., 2009).

Table 1 contains sample information including purchasing method (in store or online), expiration date, product origin, cost and packaging type for each oil. Interestingly, the three refined oils with the highest PV values (R4, R8, and R9) were stored in clear instead of tinted packaging, which is not protective against photooxidation. Another factor that can contribute high PV values is storage time. The closer an oil is to the best by date on the bottle, the more likely it has had a long storage time. In this study, however, no correlation was found between



**Fig. 2.** (a) Values for the primary oxidation products (K232) and secondary oxidation products (K270) in each oil. (b) Values for  $\Delta K$ . Bars are an average of triplicate measurements and error bars show SEM. EV stands for extra virgin, R for refined, and U for unspecified avocado oil.

the expiration date on the bottle and the PV values and all the samples were tested before reaching the expiration date. Literature values range from 1.4 to 12.74 meq  $O_2$ /kg for lab-made avocado oil samples (Bora et al., 2001; Elez-Martinez et al., 2005; Jorge, Polachini, Dias, Jorge, & Telis-Romero, 2015; Krumreich et al., 2018; Manaf et al., 2018; Ortiz Moreno et al., 2003). A study looking at two commercial virgin avocado samples in Chile, storage time unknown, saw higher PV values of 8 meq  $O_2$ /kg and 12.95 meq  $O_2$ /kg (Flores et al., 2014). All of the samples tested in this study were in those ranges, aside from EV7, at 17.9 meq  $O_2$ /kg. Coincidentally, EV7 was the most expensive sample (\$2.35/fl oz) out of the 22 samples purchased for this study.

K<sub>232</sub> is another measure of the primary oxidation products present in an oil while K<sub>270</sub> measures secondary oxidation products. Fig. 2a shows the K<sub>232</sub> values range from a low of 1.4 for sample R6 and EV1 to a high of 3.5 for sample U6. These ranges are comparable to values observed in the limited studies that have measured the specific extinction in UV in avocado oils. Ramírez-Anaya et al. (2018) saw K<sub>232</sub> values of 1.8–2.8 for centrifuge extracted oil at different malaxation temperatures (Ramírez-Anaya et al., 2018). Another study looking at commercial oils in Chile saw K<sub>232</sub> values in the range of 3.16–4.19 (Flores et al., 2014). It is likely the increase of primary oxidation products seen in commercial samples from both this study and Flores et al. (2014) compared to the values seen in Ramírez-Anaya et al. (2018) are because long storage time results in an increase of autoxidation.

Refined oils have a higher K<sub>270</sub> because refining processes create conjugated trienes, which absorb at about 270 nm. Storage time can also increase K<sub>270</sub> in avocado oils; Elez-Martinez, Soliva-Fortuny,

Gorinstein, & Martin-Belloso (2005) demonstrated that a fresh sample had a value of 0.4, which increased to 1.6 after 24 weeks (Elez-Martinez et al., 2005). In this study, the K<sub>270</sub> was higher for many of the refined (average 0.725) and the unspecified oils (average 0.865) compared to the 0.459 average of the extra virgin samples. No correlation was seen between the expiration dates and K<sub>270</sub> values. There was one unspecified oil, U4, with a particularly high K<sub>270</sub> value of 1.84, which could indicate poor quality or harsh refining processes. When looking at the extra virgin samples EV3 and EV6 had higher K<sub>270</sub> than the rest of the samples in this group. However, a K<sub>270</sub> range of approximately 0.1–0.8 was seen in fresh in-house made oils under varying malaxation conditions (Ramírez-Anaya et al., 2018). This range was also seen in a study that analyzed commercial oils labeled as virgin (best-by date unknown), and is similar to the extra virgin oils in this study (0.16–0.77) (Flores et al., 2014).

The  $\Delta K$  value can help distinguish virgin or extra virgin oil from one that is refined. The difference between a poor-quality virgin or extra virgin oil and one adulterated with refined oil can often be seen using  $\Delta K$  (Vossen, 2007). Fig. 2b summarizes the  $\Delta K$  values for the oils in this study. To the best of our knowledge, this is the first report of  $\Delta K$  values for avocado oil and we are therefore unable to compare values in this study with other literature. In the standards for olive oil from the International Olive Council, extra virgin olive oil must have a  $\Delta K$  below 0.01 (Vossen, 2007). As anticipated, all of the refined oils are either at or above this limit as are all of the unspecified avocado oils with U1 having the lowest value of 0.01. U4 has gone under significant refining, with a value of nearly 0.2. For the extra virgin samples EV1, EV2, EV4,



EV5, and EV7 are all under the extra virgin olive oil limit of 0.01. These are also the same samples that had a low  $K_{270}$ . This indicates it is likely that these oils are not adulterated with refined oils; however, some are of poor quality as they had high FFA and PV values. Interestingly, EV3 and EV6 which had low FFA and PV values and seemed to be the highest quality of the extra virgin samples had higher  $K_{270}$  and notably high  $\Delta K$  values of 0.056 and 0.047, respectively compared to the other extra virgin samples. This indicates that it is possible that these two samples are refined or are blended with refined oils; the  $\Delta K$  values for these two samples are still within the standard for refined olive oils, which must be below 0.16 (CODEX, 2017). In addition, the prices of these two samples were significantly lower than other extra virgin samples and more comparable with the refined oils.

### 3.2. Minor components

Chlorophyll pigments are what give extra virgin avocado oil its classic green color. In addition to the extra virgin labeled samples, three unspecified oils (U2, U3, and U6) were also tested as they appeared light green in color unlike the other refined oils and unspecified oils, which were light, pale yellow. The chlorophyll content ranged from 6.62 mg/kg to 98.8 mg/kg as shown in Fig. 3. EV1, EV2, EV4, EV5, and EV7 contained ~95 mg/kg chlorophyll; these oils were noticeably dark green in appearance. The chlorophyll content seen in literature ranges greatly from 1.0 mg/kg to 69.8 mg/kg (Ashton et al., 2006; Jorge et al., 2015; Krumreich et al., 2018; Werman & Neeman, 1987; Wong et al., 2011). The inclusion of skin during processing could be responsible for the high values seen in this study. However, the values seen in Wong et al. (2011) are lower than those seen in this study and in Ashton et al., 2006, which saw a chlorophyll content of to 214 mg/kg from the skin (Ashton et al., 2006; Wong et al., 2011). These variations are not unusual as the cultivar and ripeness of the fruit, extraction method, storage can all greatly impact the amount of chlorophyll in the oils. It's important to note that EV3 and EV6, which had the lowest chlorophyll content, were also the same oils that had low FFA and PV but high  $\Delta K$  and  $K_{270}$ . This also supports the hypothesis that these oils are either refined or blended with oils that are refined.

There are eight compounds that make up vitamin E content, four

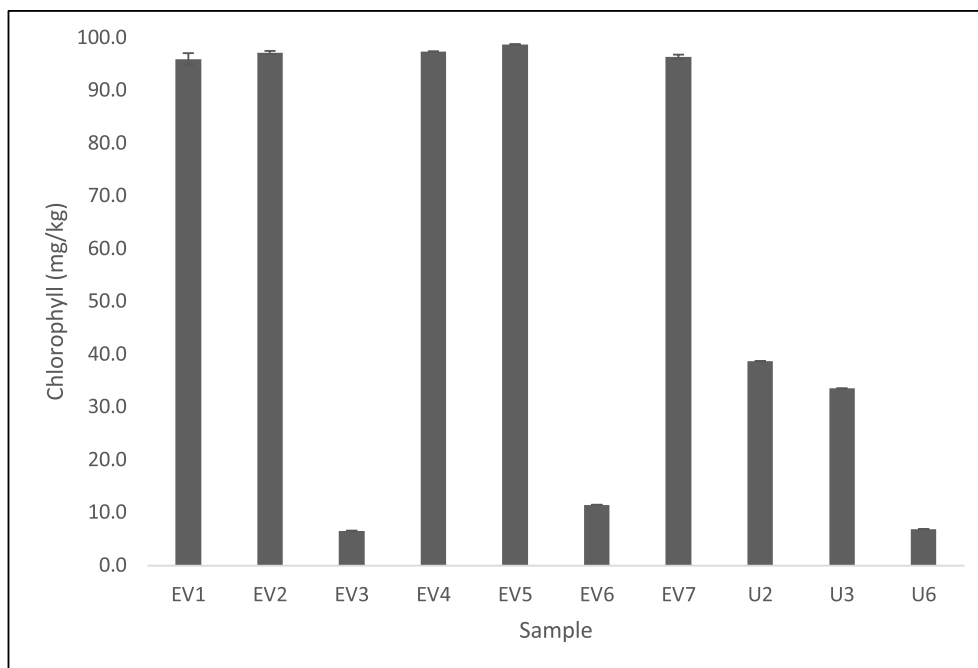
**Table 2**

Individual and total tocopherol content, expressed in mg/kg, for each avocado oil.

	$\alpha$ -Tocopherol	$\gamma + \beta$ -Tocopherol	$\delta$ -Tocopherol	Total tocopherols
EV1	155.2 $\pm$ 11.8 <sup>def</sup>	ND	ND	155.2 <sup>efghi</sup>
EV2	116.0 $\pm$ 4 <sup>gh</sup>	ND	ND	116.0 <sup>ghi</sup>
EV3	87.3 $\pm$ 3.2 <sup>hi</sup>	412.5 $\pm$ 55.4 <sup>b</sup>	145.6 $\pm$ 5.7 <sup>c</sup>	645.4 <sup>b</sup>
EV4	120.7 $\pm$ 4 <sup>efgh</sup>	ND	ND	120.7 <sup>ghi</sup>
EV5	143.3 $\pm$ 1.5 <sup>efg</sup>	ND	ND	143.3 <sup>fghi</sup>
EV6	95.9 $\pm$ 0.5 <sup>ghi</sup>	581.3 $\pm$ 67.1 <sup>a</sup>	229 $\pm$ 9.7 <sup>a</sup>	906.2 <sup>a</sup>
EV7	140.9 $\pm$ 11.9 <sup>efg</sup>	ND	ND	140.9 <sup>fghi</sup>
R1	396.7 $\pm$ 8.7 <sup>a</sup>	108.8 $\pm$ 4.7 <sup>cd</sup>	ND	505.5 <sup>c</sup>
R2	178.2 $\pm$ 2.9 <sup>cde</sup>	ND	ND	178.2 <sup>efgh</sup>
R3	194.2 $\pm$ 7.6 <sup>cd</sup>	102.6 $\pm$ 21.3 <sup>cd</sup>	ND	296.8 <sup>de</sup>
R4	34.0 $\pm$ 1.9 <sup>j</sup>	ND	ND	34.0 <sup>i</sup>
R5	116.9 $\pm$ 2.6 <sup>fgh</sup>	ND	ND	116.9 <sup>ghi</sup>
R6	194.7 $\pm$ 13.1 <sup>cd</sup>	ND	ND	194.7 <sup>efg</sup>
R7	209.3 $\pm$ 12.2 <sup>c</sup>	ND	ND	209.3 <sup>efg</sup>
R8	276.8 $\pm$ 15.3 <sup>b</sup>	ND	ND	276.8 <sup>ef</sup>
R9	49.9 $\pm$ 6.7 <sup>ij</sup>	ND	ND	49.9 <sup>hi</sup>
U1	156.8 $\pm$ 6.2 <sup>def</sup>	ND	ND	156.8 <sup>efghi</sup>
U2	52.2 $\pm$ 0.2 <sup>ij</sup>	42.4 $\pm$ 1.4 <sup>cd</sup>	ND	94.6 <sup>ghi</sup>
U3	60.1 $\pm$ 9.3 <sup>ij</sup>	41.5 $\pm$ 5.4 <sup>cd</sup>	ND	101.6 <sup>ghi</sup>
U4	317.6 $\pm$ 20.9 <sup>b</sup>	106.8 $\pm$ 5.3 <sup>cd</sup>	ND	424.4 <sup>cd</sup>
U5	388.0 $\pm$ 12.7 <sup>a</sup>	129 $\pm$ 5.2 <sup>c</sup>	ND	517.0 <sup>c</sup>
U6	91.1 $\pm$ 0.2 <sup>hi</sup>	440 $\pm$ 48.1 <sup>b</sup>	161.8 $\pm$ 6.6 <sup>b</sup>	692.9 <sup>b</sup>

ND = not detected. Data shown as the average of triplicate measurements plus minus standard error of the mean (mean  $\pm$  SEM, n = 3). Different letters (a, b, c, etc.) in each column indicate significant differences calculated using Tukey test.

tocopherols ( $\alpha$ -tocopherol,  $\beta$ -tocopherol,  $\gamma$ -tocopherol,  $\delta$ -tocopherol) and four tocotrienols. In this study, the four tocopherol compounds were quantified with beta and gamma values summed together (Table 2). Woolf et al. (2009) proposed that the tocopherol content in extra virgin avocado oil should be between 70 and 190 mg/kg (Woolf et al., 2009). Refined oils were not included in this range, as tocopherols are largely removed in the refining process. For all but three samples (EV3, EV6 and U6) in this study, alpha tocopherol was the highest concentration, followed by gamma, then delta which is consistent with literature (Fernandes et al., 2018; Madawalaa, Kochharb, &



**Fig. 3.** Total chlorophyll content determined by AOCS official method Cc 13d-55. Measurements are done in triplicate with error bars indicating SEM. EV stands for extra virgin, R for refined, and U for unspecified avocado oil.



Duttaa, 2012; Manaf et al., 2018). However, the varietal can significantly impact the tocopherol content, for the Bacon avocado variety gamma tocopherol is higher than alpha (Fernandes et al., 2018). The lowest total tocopherol contents in this study were seen in R4 (34.0 mg/kg) and R9 (49.9 mg/kg). This study shows multiple samples (EV3, EV6, R1, U4, U5, U6) had total tocopherol contents over 400 mg/kg, which is interesting as the highest documented total tocopherol content in literature, to our knowledge, is 282 mg/kg (Corzzini et al., 2017). In particular, there are three samples with a notably high total tocopherol content, EV3, EV6 and U6 at 645.4 mg/kg, 906.2 mg/kg, and 692.9 mg/kg, respectively. These samples had significantly higher levels of gamma and delta tocopherols compared to the other samples in this study and to values seen in literature for avocado oils. A study that reported on the tocopherol content in fruits and vegetables (Chun, Lee, Ye, Exler, & Eitenmiller, 2006), showed soybean oil has similar tocopherol levels and distributions to those seen in EV3, EV6 and U6, therefore, it is possible these samples contain soybean or had soybean tocopherols added after processing for preservation.

### 3.3. Purity parameters

Fatty acid profile is commonly used as a part of purity parameters to determine if an oil is adulterated. Table 3 shows the fatty acid profiles of all the samples which are consistent with literature with the exception of EV3, EV6 and U6. These three oils had a linolenic acid (C18:3) values of 8.2–9.8%, while one of the highest values seen in literature was 3.19% in Hass variety (Tan et al., 2017). These oils also had a linoleic acid (C18:2) content of ~55%, substantially higher than seen in the other avocado oils in this study and from literature values, which were approximately 20% (Manaf et al., 2018; Tan et al., 2017). These oils also had high stearic acid (C18:0); low oleic (C18:1) and palmitic (C16:0) acids and their values for the fatty acid profile fit in the parameters for soybean oils from the CODEX standards for named vegetable oils (CODEX, 2017). The other oils in this study all had values comparable to literature with the exception of stearic acid (C18:0), which is higher in R1, R2, R3, R7, R8, U1, U4, and U5 than has been seen previously in literature (Berasategi, Barriuso, Ansorena, & Astiasarán, 2012; Bora et al., 2001; Fernandes et al., 2018; Forero-Doria, García, Vergara, & Guzman, 2017; Noorzyanna, Marikkar, Mustafa, & Mat Sahri, 2017; Ortiz Moreno et al., 2003; Woolf et al., 2009). Samples R1, U4 and U5 also had lower palmitoleic acid (C16:1) compared to what

has been reported in literature (Berasategi et al., 2012; Bora et al., 2001; Fernandes et al., 2018; Forero-Doria et al., 2017; Ortiz Moreno et al., 2003; Ozdemir & Topuz, 2004; Tan et al., 2017). These deviations seen in the fatty acid profile could be a result of economic adulteration, however, due to lack of standards, one cannot easily make such claims. To support the establishment of standards, we need to build a database that includes natural variances such as climate, varietal, and growing region can impact the fatty acid profile of avocado oil.

The sterols profile is another purity parameter often used in conjunction with the fatty acid profile. Table 4 shows the sterols in all the samples. Samples EV3, EV6, and U6 had lower value of  $\beta$ -sitosterol of ~55% and higher values of campesterol and stigmasterol of ~20% and ~15%, respectively, which matched the sterols profile of soybean oil according to the CODEX standards. All other oils had values comparable to what has typically been seen in literature (Fernandes et al., 2018; Jorge et al., 2015; Madawalaa et al., 2012) with the exception of R1, U4 and U5. These oils are characterized by slightly higher amounts of campesterol, stigmasterol,  $\Delta$ -7 stigmatsterol and  $\Delta$ -7 avensterol and lower  $\beta$ -sitosterol. However, it has been shown avocado oil can have a  $\beta$ -sitosterol content as low as 73.9 mg/kg (Berasategi et al., 2012) and changes in extraction conditions can increase campesterol to values comparable to those seen in R1, U4, and U5 (Dos Santos et al., 2014). Like with the fatty acid profile results, a standard that accommodates natural variables such as cultivar, fruit maturity, irrigation and extraction methods and discriminates pure avocado oil from adulterated one is needed in order to use sterols as a purity indicator for samples like R1, U4, and U5.

TAG profiles were determined for each oil and plotted using PCA as in Green et al. (2020) (Green et al., 2020). Fig. 4 shows samples EV3, EV6, and U6 are located around the soybean oil cluster indicating they are likely 100% soybean oil and corroborating the fatty acid and sterols profiles. All other avocado samples are in a separate group, close to the olive oils. This is expected as avocado, like olive oil, is high in TAGs containing oleic fatty acid and low in linoleic and linolenic. However, there are three samples R1, U4, and U5 are slightly removed from the other avocado oils in the cluster. These samples also have multiple values for their fatty acids and sterols profiles that are outside the range of 2xSD from pure samples in this study. This could be due to natural variance of the avocado fruits, processing conditions, or economic adulteration with high oleic sunflower or safflower oils. Preliminary analysis using the CODEX standards for vegetable oils suggested that

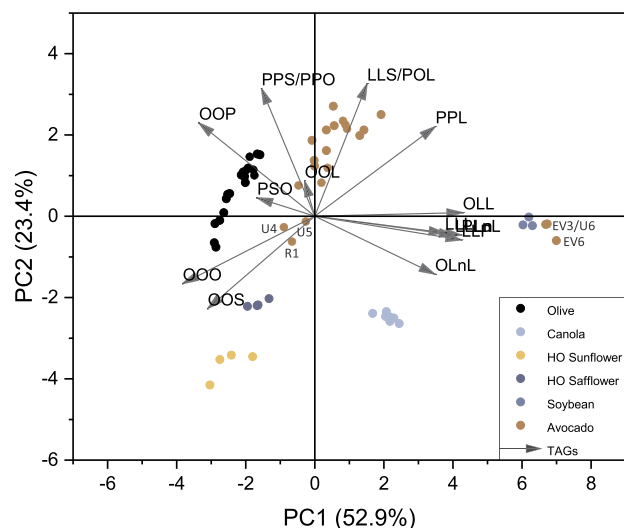
**Table 3**  
Fatty acid profile expressed as percent of total fatty acids for each avocado oil.

	C14:0	C16:0	C16:1	C18:0	C18:1	C18:2	C18:3	C20:0	C20:1	C22:0	C24:0
EV1	ND	16.5 ± 0.1	6.9 ± 0	0.5 ± 0	55.6 ± 0.1	19.2 ± 0.1	1.2 ± 0	ND	0.1 ± 0.1	ND	ND
EV2	0.1 ± 0	15.6 ± 0	6.5 ± 0	0.5 ± 0	61.0 ± 0	15.2 ± 0	1.0 ± 0	ND	0.2 ± 0	ND	ND
EV3	0.1 ± 0	10.9 ± 0	0.1 ± 0	4.0 ± 0	21.4 ± 0.1	54.4 ± 0.1	8.2 ± 0	0.3 ± 0	0.2 ± 0	0.3 ± 0	0.1 ± 0
EV4	0.1 ± 0	15.5 ± 0	6.4 ± 0	0.5 ± 0	59.3 ± 0.1	17.0 ± 0.1	1.1 ± 0	ND	0.2 ± 0	ND	ND
EV5	0.1 ± 0	15.6 ± 0	6.4 ± 0	0.5 ± 0	58.6 ± 0	17.5 ± 0	1.1 ± 0	ND	0.2 ± 0	ND	ND
EV6	0.1 ± 0	10.4 ± 0	0.1 ± 0	3.8 ± 0	19.7 ± 0.5	55.4 ± 0.4	9.8 ± 0	0.4 ± 0	0.2 ± 0	0.3 ± 0	0.1 ± 0
EV7	ND	16.0 ± 0	6.6 ± 0	0.5 ± 0	62.4 ± 0	13.4 ± 0	0.9 ± 0	ND	0.2 ± 0	ND	ND
R1	ND	10.0 ± 0	1.7 ± 0	2.3 ± 0	69.1 ± 0	15.2 ± 0	0.5 ± 0	0.3 ± 0	0.3 ± 0	0.4 ± 0	0.2 ± 0
R2	ND	14.7 ± 0	5.8 ± 0	1.4 ± 0	64.4 ± 0.1	12.2 ± 0	0.7 ± 0	0.2 ± 0	0.3 ± 0	0.2 ± 0	0.1 ± 0
R3	ND	13.2 ± 0	4.2 ± 0	1.4 ± 0	63.8 ± 0.1	16.0 ± 0.1	0.7 ± 0	0.2 ± 0	0.3 ± 0	0.2 ± 0	0.1 ± 0
R4	ND	15.8 ± 0	6.8 ± 0	0.5 ± 0	63.8 ± 0	12.0 ± 0	0.8 ± 0	ND	0.2 ± 0	ND	ND
R5	ND	15.0 ± 0	6.5 ± 0	0.8 ± 0	63.6 ± 0	12.8 ± 0	0.8 ± 0	0.1 ± 0	0.2 ± 0	0.1 ± 0	ND
R6	ND	17.8 ± 0	8.6 ± 0	0.6 ± 0	61.0 ± 0.1	10.9 ± 0	0.8 ± 0	0.1 ± 0	0.2 ± 0	ND	ND
R7	ND	14.4 ± 0	5.2 ± 0	1.4 ± 0	64.8 ± 0	13.0 ± 0	0.7 ± 0	0.2 ± 0	0.2 ± 0	0.2 ± 0	0.1 ± 0
R8	ND	13.4 ± 0	5.1 ± 0	1.6 ± 0	67.5 ± 0	10.9 ± 0	0.6 ± 0	0.2 ± 0	0.2 ± 0	0.3 ± 0	0.1 ± 0
R9	ND	14.1 ± 0	5.2 ± 0	1.0 ± 0	63.2 ± 0	15.0 ± 0	0.8 ± 0	0.2 ± 0	0.2 ± 0	0.1 ± 0	0.1 ± 0
U1	ND	16.5 ± 0	7.4 ± 0	1.3 ± 0	63.9 ± 0	9.8 ± 0	0.7 ± 0	0.2 ± 0	0.2 ± 0	ND	ND
U2	ND	16.4 ± 0	7.2 ± 0	0.6 ± 0	60.0 ± 0	14.7 ± 0	0.9 ± 0	ND	0.2 ± 0	ND	ND
U3	ND	16.5 ± 0	7.4 ± 0	0.6 ± 0	60.4 ± 0	13.9 ± 0	0.8 ± 0	0.1 ± 0	0.2 ± 0	ND	ND
U4	ND	10.4 ± 0	2.0 ± 0	2.1 ± 0	66.5 ± 0	17.4 ± 0	0.5 ± 0	0.4 ± 0	0.3 ± 0	0.2 ± 0	0.1 ± 0
U5	0.1 ± 0	11.2 ± 0	0.6 ± 0	2.8 ± 0	68.3 ± 0	15.4 ± 0	0.5 ± 0	0.4 ± 0	0.3 ± 0	0.4 ± 0	0.2 ± 0
U6	0.1 ± 0	10.9 ± 0	0.1 ± 0	4.0 ± 0	21.0 ± 0	54.7 ± 0	8.2 ± 0	0.3 ± 0	0.2 ± 0	0.3 ± 0	0.1 ± 0

ND = not detected. Data shown as (mean ± SEM, n = 2).

Table 4

	Brassicasterol	Campesterol	Stigmasterol	$\Delta 7$ -campesterol	Clerosterol (II)	$\beta$ -sitosterol (III)	$\Delta 5$ - Avenasterol	$\Delta 7$ - Stigmasterol	$\Delta 7$ -Avenasterol	Total Sterols
EV1	0.4 $\pm$ 0.4	5.5 $\pm$ 0	0.8 $\pm$ 0.2	ND	1.9 $\pm$ 0.1	85.6 $\pm$ 0.5	5.7 $\pm$ 0.3	ND	ND	5955 $\pm$ 110
EV2	ND	5.4 $\pm$ 0.3	ND	ND	1.9 $\pm$ 0.1	86.8 $\pm$ 0.7	5.8 $\pm$ 0.3	ND	ND	4670 $\pm$ 200
EV3	ND	20.3 $\pm$ 0.1	15.8 $\pm$ 0.1	ND	ND	56.3 $\pm$ 0.1	2.7 $\pm$ 0	2.8 $\pm$ 0.2	2.1 $\pm$ 0.3	2601 $\pm$ 75
EV4	ND	5.6 $\pm$ 0.1	0.6 $\pm$ 0	ND	1.8 $\pm$ 0	86 $\pm$ 0.3	6.0 $\pm$ 0.3	ND	ND	5649 $\pm$ 200
EV5	ND	5.8 $\pm$ 0	0.6 $\pm$ 0	ND	1.9 $\pm$ 0	85.4 $\pm$ 0.3	6.3 $\pm$ 0.3	ND	ND	5245 $\pm$ 140
EV6	ND	23.3 $\pm$ 0.1	15 $\pm$ 0.2	ND	ND	55.2 $\pm$ 0.1	3.8 $\pm$ 0.2	1.5 $\pm$ 0.1	1.3 $\pm$ 0.1	3306 $\pm$ 0
EV7	ND	6.3 $\pm$ 0	ND	ND	1.9 $\pm$ 0	86.3 $\pm$ 0.1	5.6 $\pm$ 0.1	ND	ND	4263 $\pm$ 31
R1	ND	8.6 $\pm$ 0.2	4.6 $\pm$ 0.1	ND	0.9 $\pm$ 0	75.6 $\pm$ 0.2	4.5 $\pm$ 0.2	4.3 $\pm$ 0.1	1.4 $\pm$ 0.2	2906 $\pm$ 10
R2	ND	5.7 $\pm$ 0	1.4 $\pm$ 0	ND	1.2 $\pm$ 0	85.7 $\pm$ 0.1	4.6 $\pm$ 0.1	1.5 $\pm$ 0.1	ND	3356 $\pm$ 48
R3	ND	7.6 $\pm$ 0.3	2.2 $\pm$ 0.2	ND	1.3 $\pm$ 0.1	81.4 $\pm$ 1.9	5.2 $\pm$ 0	2.2 $\pm$ 2.2	ND	3362 $\pm$ 56
R4	ND	4.9 $\pm$ 0	0.4 $\pm$ 0	ND	1.4 $\pm$ 0	87.1 $\pm$ 0	5.6 $\pm$ 0.1	ND	ND	3850 $\pm$ 3.0
R5	ND	5.6 $\pm$ 0	0.9 $\pm$ 0	ND	1.3 $\pm$ 0	86.0 $\pm$ 0	5.2 $\pm$ 0	0.5 $\pm$ 0	ND	3926 $\pm$ 14
R6	ND	6.3 $\pm$ 0	0.6 $\pm$ 0	ND	1.5 $\pm$ 0	86.5 $\pm$ 0.1	5.1 $\pm$ 0.1	ND	ND	3553 $\pm$ 25
R7	ND	5.8 $\pm$ 0	1.3 $\pm$ 0	ND	1.2 $\pm$ 0	87 $\pm$ 0.1	4.8 $\pm$ 0.1	ND	ND	3344 $\pm$ 74
R8	ND	6.1 $\pm$ 0.1	2.5 $\pm$ 0	ND	1.3 $\pm$ 0.1	81.1 $\pm$ 0.3	4.6 $\pm$ 0.2	3.4 $\pm$ 0	1.2 $\pm$ 0.1	3168 $\pm$ 170
R9	ND	9.1 $\pm$ 0	2.1 $\pm$ 0	ND	1.4 $\pm$ 0	81.4 $\pm$ 0.1	5.9 $\pm$ 0.1	ND	ND	4125 $\pm$ 73
U1	0.4 $\pm$ 0.4	6.0 $\pm$ 0	0.6 $\pm$ 0.2	ND	1.2 $\pm$ 0	88.4 $\pm$ 0.4	3.5 $\pm$ 0.2	ND	ND	2859 $\pm$ 70
U2	ND	7.7 $\pm$ 0.6	1.1 $\pm$ 0	ND	1.6 $\pm$ 0	83.5 $\pm$ 1.1	6.0 $\pm$ 0.5	ND	ND	4066 $\pm$ 250
U3	ND	6.8 $\pm$ 0.2	1.1 $\pm$ 0	ND	1.6 $\pm$ 0	84.9 $\pm$ 0	5.6 $\pm$ 0.2	ND	ND	4340 $\pm$ 69
U4	ND	10.1 $\pm$ 0.1	3.8 $\pm$ 0.1	0.7 $\pm$ 0	0.9 $\pm$ 0.1	74.7 $\pm$ 0	4.6 $\pm$ 0.2	4.0 $\pm$ 0.2	1.2 $\pm$ 0.1	3341 $\pm$ 95
U5	ND	9.2 $\pm$ 0.1	4.8 $\pm$ 0.1	ND	ND	77 $\pm$ 0.2	3.6 $\pm$ 0.1	4.2 $\pm$ 0.2	1.2 $\pm$ 0.1	3465 $\pm$ 66
U6	ND	20.6 $\pm$ 0.2	16.2 $\pm$ 0.4	ND	ND	56 $\pm$ 0.4	2.5 $\pm$ 0.3	2.8 $\pm$ 0.3	1.8 $\pm$ 0.1	2678 $\pm$ 130



50:50 adulteration of avocado oil: high oleic sunflower could yield similar profiles as samples R1, U4, and U5.

This study demonstrates, for the first time, there are problems in both quality and purity in the store-bought extra virgin and refined avocado oil. The majority of the samples were of low quality with five of the seven oils labeled as “extra virgin” having high FFA values and six of the nine “refined” oils had high PV. FFA, PV, and specific extinction in UV data demonstrated that these oils have undergone lipolysis and oxidation, respectively. This likely resulted from improper or prolonged storage, using damaged or rotten fruits, or extreme and harsh processing conditions. Extra virgin oils often are more expensive and distinguished from lower grades such as virgin or crude oils using the above quality parameters.

### Author contributions

## CRedit authorship contribution statement

### Declaration of competing interest

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# EXHIBIT 5



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# Why your avocado oil may be fake and contain other cheap oils

Scientists say adulteration is rampant in the avocado oil industry, and many people are being misled by some of the nation's largest retail chains.

August 27, 2024

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By [Anahad O'Connor](#) and [Aaron Steckelberg](#)

Avocado oil is a rising star in the culinary world. It's a heart-healthy cooking oil with a mild flavor that appeals to health-conscious consumers.

But scientists say that adulteration and mislabeling are rampant in the avocado oil industry, and that many people who believe they're buying pure avocado oil are being misled by some of the nation's largest retail chains.



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Scientists at the University of California at Davis tested avocado oil samples, and have for the first time revealed the names of a dozen retailers who they say sold products labeled as avocado oil that contained cheap seed and vegetable oils, including Walmart, Sam's Club, Kroger and Safeway. The companies didn't respond to requests for


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The researchers found that at least 21 of the products labeled as avocado oil — nearly two-thirds of the 36 bottles they tested— were adulterated, in some cases with other oils that could pose a hazard to people with food sensitivities. The newly released findings are based on tests conducted in 2021 on bottles of store-brand avocado oil purchased from 19 large grocery stores in the United States and Canada.

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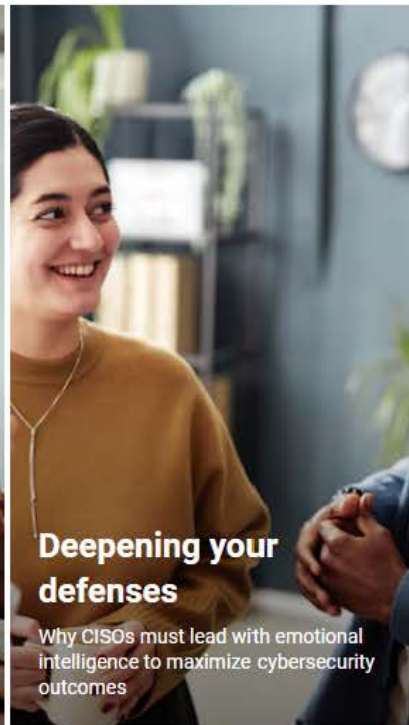
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Other retailers whose products failed testing said they couldn't verify findings based on bottles of oil produced in 2020 or 2021. Some retailers confirmed they don't do their own testing and instead rely on suppliers and third-party services to verify the purity of the oil.



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Retailers have a "responsibility to make sure that what's on the label is consistent with the product itself," said Selina Wang, the scientist who



led the research and an associate food science professor at the University of California at Davis. “Based on our research that’s simply not the case.”

In a statement, the Food and Drug Administration acknowledged that “high value oils” such as avocado oil “are potential targets for economically motivated adulteration.” “The FDA does not comment on specific studies,” an FDA official said, “but evaluates them as part of the body of evidence to further our understanding about a particular issue.”

## How cheap avocado oil is made

Avocado oil is the fastest-growing segment of the edible oils market, with global sales of more than half a billion dollars. The UC-Davis research suggested that low-priced avocado oils were the most likely to be adulterated. Most major retailers do not produce their own avocado oil, and instead buy it from suppliers, bottle it and put their store labels on it.



Much of the avocado oil sold by retailers is “refined,” which means it’s a lower-quality, highly-processed oil that is bleached, deodorized and filtered. (Virgin and extra virgin oils are “unrefined” and typically pressed from high-quality avocados without using heat or chemicals.)

### UNREFINED (less processed)

Generally means no additional refining takes place after the fruit is pressed to extract the oil. Labels will usually include the words **cold-pressed**, **virgin** or **extra virgin**.



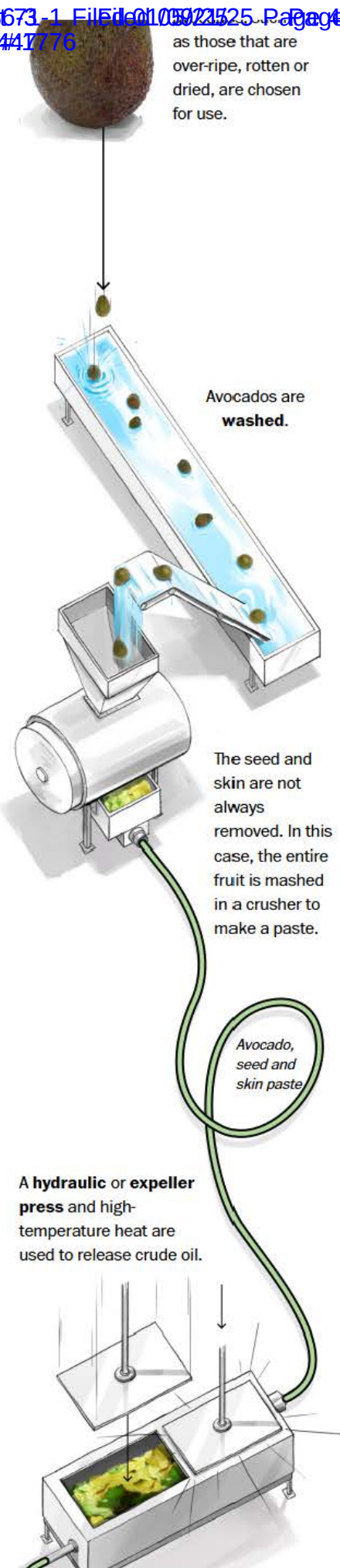
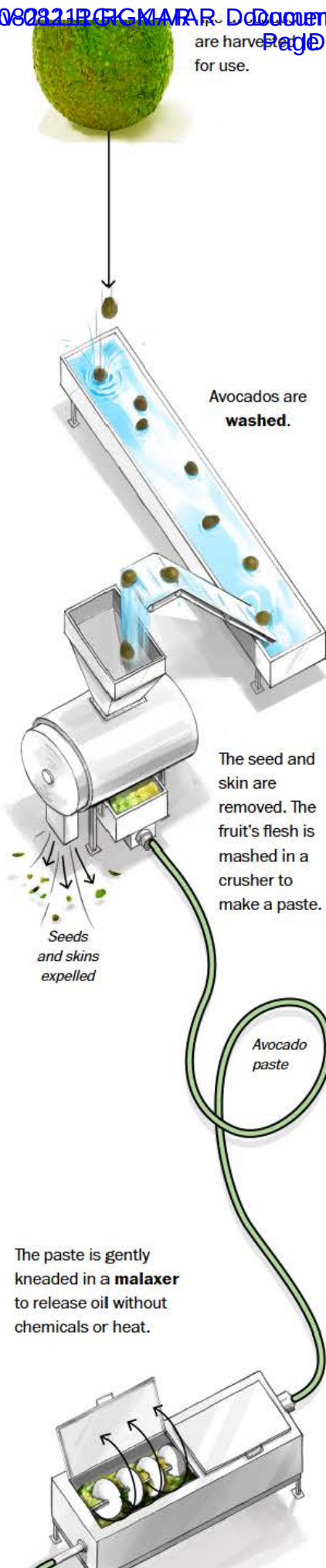
Higher-quality,  
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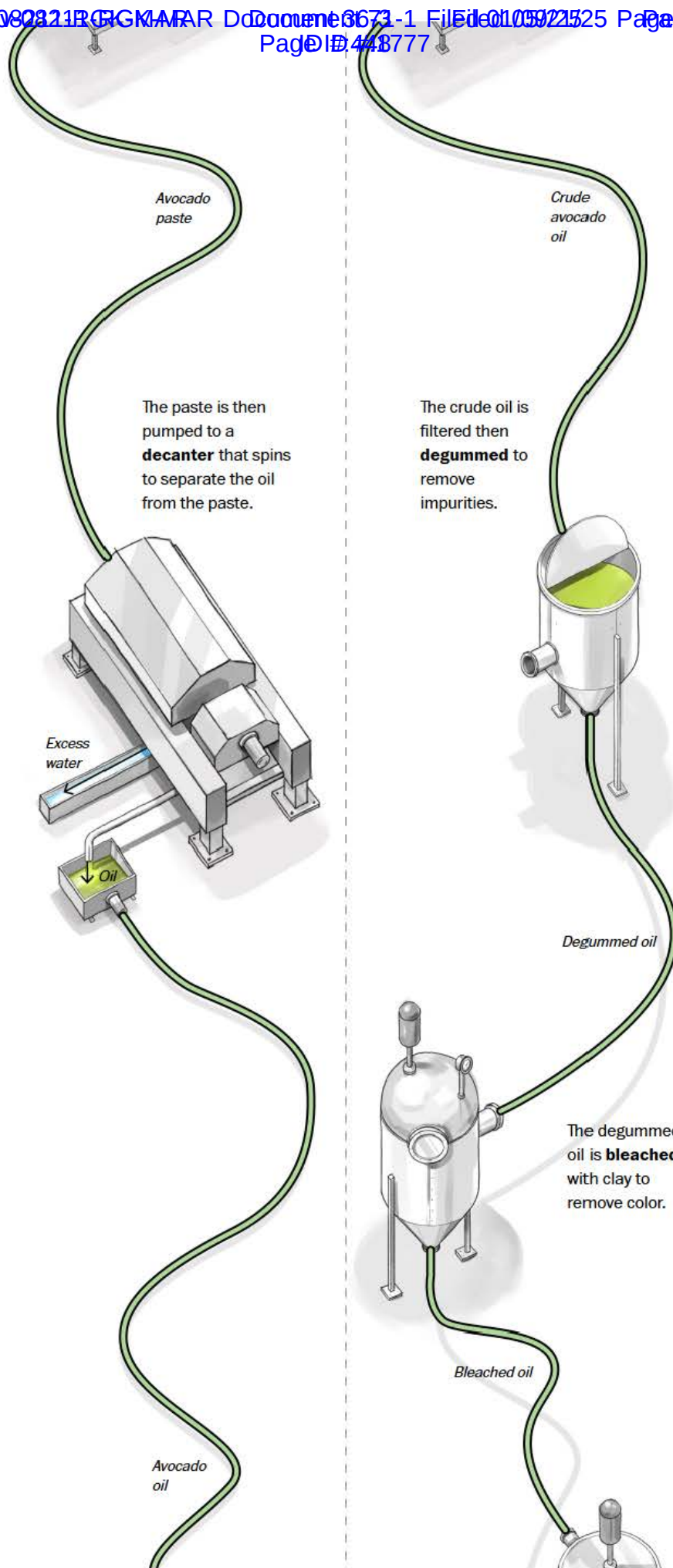
### REFINED (more processed)

This indicates that additional steps are taken to refine the oil after it is extracted from the fruit. This may include **degumming**, **neutralization**, **bleaching** and/or **deodorization**.

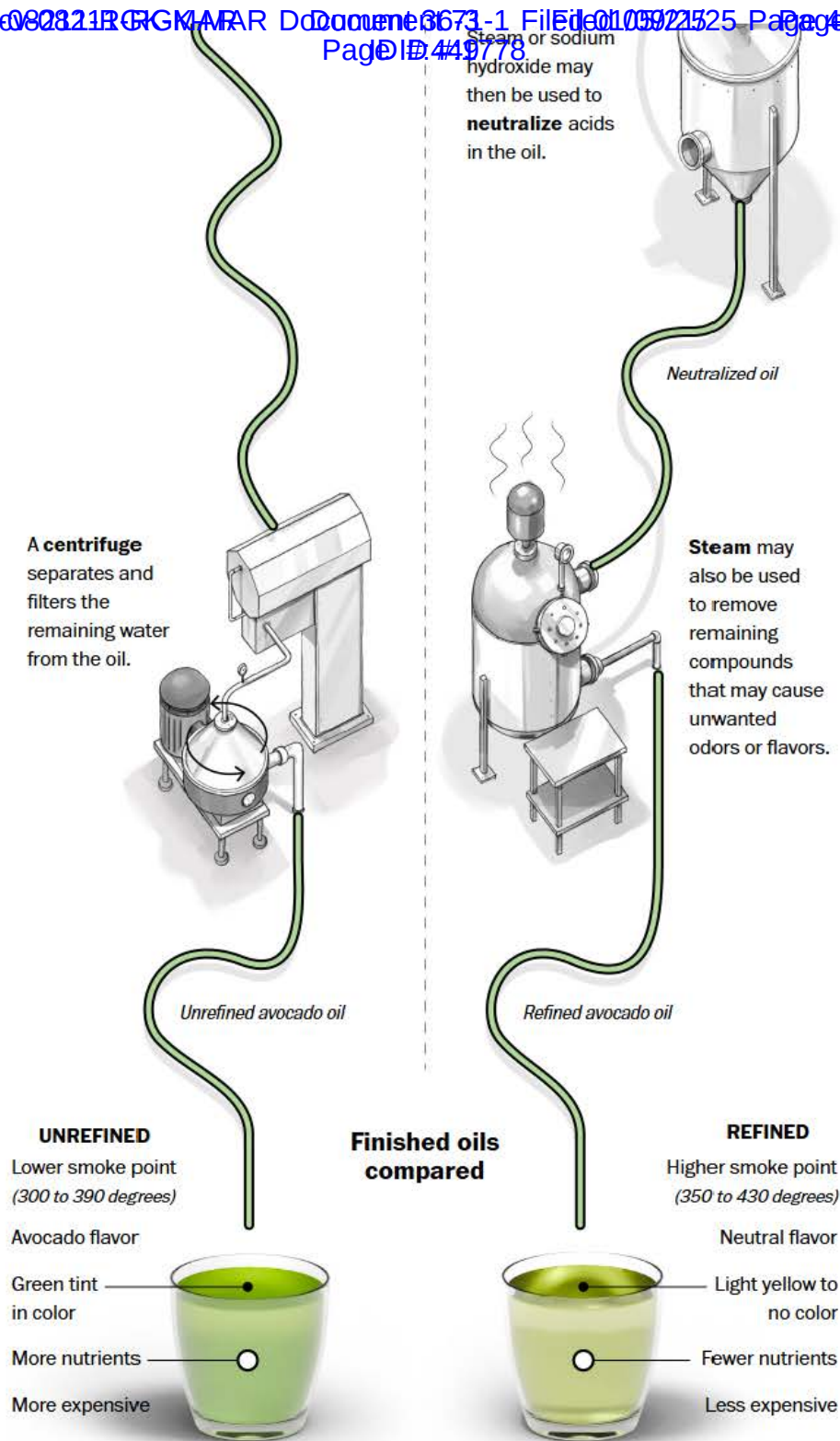


Lower-quality  
avocados such









## Suppliers selling fake avocado oil

The popularity of avocado oil is largely due to the health halo around avocados. Avocado oil is rich in heart-healthy monounsaturated fats, antioxidants, minerals and vitamin E.

Avocado oil is relatively expensive to produce, and retail stores that buy

it from suppliers at unrealistically low prices should have some idea that they're not getting the real thing, Wang said. "If a buyer finds that an oil is quite a bit lower in price compared to others, there's probably a reason for that," she added.



Some suppliers and producers said it's an open secret that adulteration is rampant in the avocado oil industry. Ben Barnard, the founder and chairman of AvoPacific, one of the largest avocado oil producers in North America, said he has seen competitors selling refined avocado oil to retailers for prices so low that it would not be possible for them to make a profit if their avocado oil was real.

"We were getting undercut by more than 50 percent in some cases and kind of being laughed at," Barnard said. "If you just followed the numbers, anyone in the industry could have told you what was going on."

The company said that most of its oil is sold under its own label, AvoPacific. In 2020, UC-Davis tested an AvoPacific oil sold under the brand name "CalPure Extra Virgin Avocado Oil," and it passed their tests.

## The avocado oil brands that failed testing

The avocado oil researchers initially published their findings in a scientific journal last fall without disclosing the names of the adulterated products. But at the request of The Washington Post, the researchers agreed to disclose the names of the brands that failed their tests because adulterated oils can put people with food sensitivities at risk.

The tests showed that six retailers — Walmart, Trader Joe's, Aldi, Metro, Meijer and Kroger — sold bottles labeled as avocado oil that contained high levels of oleic sunflower or safflower oils. These oils are less expensive than avocado oil and have different health and culinary



properties. At Target and Sprouts Farmers Market, the researchers found bottles of store-brand avocado oil that their tests indicated contained canola oil, a less expensive cooking oil.



Researcher Selina Wang, the lead author of the avocado oil study, looks at an oil sample before testing it for purity. (Jyotsna Bhamidipati for The Washington Post)

In some cases, the tests showed that bottles labeled avocado oil contained other oils that could not be identified. The researchers said they found that sunflower, safflower, canola, and soybean oils were the most common adulterants in products labeled as avocado oil. These oils look similar to refined avocado oil but are cheaper to make.

Price was not always a reliable indicator of adulteration. One of the most expensive products included in the study was Stop & Shop's store-brand "extra-virgin" avocado oil, which sells for close to \$9 for an 8.45-ounce bottle, or more than a dollar per ounce. The researchers tested two bottles of the product and found that both contained oils that were neither extra virgin nor avocado oil. It was unclear what type of oil or oils were in the bottles.

Stop & Shop's cold-pressed "Extra Virgin" avocado oil was the only

extra-virgin oil in the study that was found to be adulterated with other oils.

## Retailers dispute the findings

In general, retailers who responded to questions about the adulterated oils said it's impossible for them to verify findings based on bottles of oil tested that were made in 2020 or 2021.

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In a statement, Stop & Shop said that the avocado oil included in the UC-Davis study was procured from a former supplier and that it is no longer available in its stores. "Our current supplier of store brand extra virgin avocado oil has provided a certification that the store brand extra virgin avocado oil is extra virgin avocado oil," the company said. "Stop & virgin avocado oil is extra virgin avocado oil," the company said. "Stop & Shop continues to work with the current supplier to provide customers with a great product at a great value."

The company would not say who its previous supplier was, but it added that it was incorporating "our own routine testing."

Trader Joe's said in a statement that its suppliers and "certified third-party labs" use industry-standard testing procedures to evaluate their avocado oil for quality and authenticity. "Based on the results of this testing, we believe Trader Joe's Avocado Oil is 100 percent avocado oil," the company said. The company added that it could not retest the batches that were included in the study because the products were no longer sold in its stores.

The avocado oils that were collected for samples and testing. (Jyotsna Bhamidipati for The Washington Post)

A spokesperson for Metro said the results of the UC-Davis study do not match company records that show its avocado oils meet standards. "Additionally, the Canadian Food Inspection Agency tested samples of



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A spokesperson for Target said the company requires its manufacturing partners to comply with all federal, state, and local regulations. "While we were unaware of the report's findings with these products, we will work with our manufacturing partners to evaluate these claims," the spokesperson said.

A spokesperson for Sprouts Farmers Market said the company "places the utmost importance on the quality, integrity and transparency of our Sprouts Brand products. Our Sprouts Brand avocado oil met required standards for purity when the product was manufactured in 2020."

Bottles of store-brand avocado oil purchased from Safeway, ShopRite

A spokesperson for Target said the company requires its manufacturing partners to comply with all federal, state, and local regulations. "While we were unaware of the report's findings with these products, we will work with our manufacturing partners to evaluate these claims," the spokesperson said.

A spokesperson for Sprouts Farmers Market said the company "places the utmost importance on the quality, integrity and transparency of our Sprouts Brand products. Our Sprouts Brand avocado oil met required standards for purity when the product was manufactured in 2020."

Bottles of store-brand avocado oil purchased from Safeway, ShopRite and Sam's Club were also found to be adulterated with other oils. In a statement, ShopRite said that it was in the process of reviewing the findings and that it had asked its supplier to test lot samples from the avocado oil that was included in the study. "Our vendor has assured us the avocado oil in question is not adulterated," the company said. "Nevertheless, we will be conducting our own third-party investigation

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Walmart, Sam’s Club, Safeway, Aldi, and Kroger didn’t respond to requests for comment. A spokesperson for Fresh Thyme, the brand that was purchased from Meijer, declined to comment.

Wang at UC-Davis said retailers should not rely solely on certifications from suppliers for products that are at high risk of being adulterated. “Retailers should do their own testing to ensure that the label on the bottle is consistent with the product in the bottle,” she said.

Wang said it was possible in cases where a retailer did its own independent testing that their results might differ from UC-Davis’s test results if different lots were tested or if the retailer used multiple suppliers. “We have observed significant differences in the quality and purity of oil from different lot numbers, even when sourced from the same retailer,” she added.

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“If a buyer finds that an oil is quite a bit lower in price compared to others, there’s probably a reason for that.”

In their study, Wang and her co-author, Hilary S. Green, found that refined avocado oils, particularly those that listed Spain as their country of origin, were the most likely to be adulterated. At least one out of the

In some cases, the UC-Davis researchers discovered striking variation within individual brands.

“If you just followed the numbers, anyone in the industry could have told you what was going on.”

— Ben Barnard, founder and chairman of AvoPacific

For instance, tests indicated that a bottle of Wegmans refined and expeller-pressed “Pure Avocado Oil” was mixed or substituted with a different oil. But when the researchers tested a bottle of Wegmans “Extra Virgin” avocado oil, they found that it contained pure avocado oil.

In a statement, Wegmans said that its supplier sends every lot of its avocado oil to a third-party lab for analysis. “Product does not leave our supplier’s facility until they have the results, and it is confirmed that what’s on the label is what’s in the bottle,” the company said. “We also occasionally do our own testing to ensure the legitimacy of our products.”

The company said that in April, an independent lab tested samples of its store-brand avocado oils, purchased from Wegmans’s store shelves, and that the samples were found to be free from adulteration.

## Avocado oils that failed testing

### Tested as not pure avocado oil

#### Refined avocado oil

BRAND (STORE)	ORIGIN(S)	NOTES
Great Value (Walmart)	Mexico	High oleic sunflower or safflower oil
Great Value (Walmart)	Mexico	Failed both fatty acid & sterol tests
Great Value (Walmart)	Spain	“Tested impure”
Sprouts	Mexico, South Africa, France	Canola Oil
Sprouts	Mexico, South Africa, France	Canola Oil

#### Refined & expeller pressed

Good & Gather (Target)	Mexico	Tested “no” on both criteria
Wegmans	Mexico	Failed both fatty acid & sterol tests



Good & Gather (Target) Mexico Canola Oil

#### Cold pressed & refined

Fresh Thyme (Meijer)	Spain	High oleic sunflower or safflower oil
Fresh Thyme (Meijer)	Spain	"Tested impure"
Private Selection (Kroger)	Spain	High oleic sunflower or safflower oil
Private Selection (Kroger)	Spain	"Tested impure"

#### Cold pressed

Bowl and Basket (ShopRite)	Spain	"Tested impure"
Olivari (Sam's Club)	Spain	"Tested impure"
Simply Nature (Aldi)	Spain	High oleic sunflower or safflower oil
Simply Nature (Aldi)	Spain	"Tested impure"

#### Extra Virgin

Stop and Shop	Spain	"Not 100% avocado oil"
Stop and Shop	Spain	"Not 100% avocado oil"

#### Unspecified

Signature Select (Safeway)	Mexico	Failed both fatty acid and sterol tests
Signature Select (Safeway)	Mexico	Failed both fatty acid and sterol tests
Trader Joe's	Mexico	High oleic sunflower or safflower oil

Oils listed above failed purity tests for both the Codex Alimentarius – an international set of standards, guidelines and codes to ensure purity – and the criteria set by researchers.

## Avocado oil brands that passed purity testing

### Tested as pure avocado oil

#### Refined avocado oil

BRAND (STORE)	ORIGIN(S)
Simple Truth (Kroger)	U.S. and Mexico
Simple Truth (Kroger)	U.S. and Mexico

#### Refined and expeller pressed

365 (Whole Foods)	France
365 (Whole Foods)	France
Good & Gather (Target)	South Africa
Good & Gather (Target)	South Africa

#### Virgin

President'sChoice	Mexico
-------------------	--------

#### Extra virgin

President'sChoice	Mexico
Wedmans	Mexico

### Unspecified

Harvest Peak	Mexico
--------------	--------

Oils listed above passed purity tests for both the Codex Alimentarius — an international set of standards, guidelines and codes to ensure purity — and the criteria set by researchers.

## Problems in the edible oil industry

Wang was part of a team that garnered international attention in 2010 for a study that revealed that most imported olive oils labeled “extra virgin” were not extra virgin at all. The findings led to the creation of a California olive oil commission and the adoption of stricter labeling standards.

Wang turned her attention to avocado oil when she heard rumors that some producers were knowingly selling rancid and adulterated oils. She said she had also received messages from people with food allergies who were worried about unknowingly being exposed to food allergens because of adulterated avocado oil.

Wang said the Food and Drug Administration needs to adopt an official “standard of identity” for avocado oil, which would describe in detail the characteristics that an oil must have to be sold as avocado oil. The FDA has established these standards for more than 250 foods, including milk, peanut butter, ketchup, milk chocolate, bread and jam. But avocado oil does not yet have a standard of identity.

*Do you have a question about healthy eating? Email EatingLab@washpost.com and we may answer your question in a future column.*

---

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# EXHIBIT 6

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# Evidence-Based Health Benefits of Avocado Oil



Medically reviewed by  
Adrienne Seitz, MS, RD,  
LDN, Nutrition — Written by  
Hrefna Palsdottir, MS —  
Updated on November 26,  
2024

Heart health | Eye benefits | Nutrient absorption | Arthritis relief |  
Many antioxidants | Takeaway

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Avocado oil is delicious, nutritious, and easy to use. It's rich in oleic acid, polyunsaturated fats, carotenoids, and other antioxidant-rich nutrients that are linked to improved heart, skin, and eye health.

Avocado oil is the natural oil pressed from the pulp of an avocado. About 60% of avocado oil consists of heart-healthy oleic acid, a monounsaturated omega-9 fatty acid.

This fatty acid is also the main component of olive oil and is believed to be partly responsible for its health benefits. Additionally, around 12% of avocado oil is saturated fat, and about 13% is polyunsaturated fat.

## Reduces cholesterol and improves heart health


One rat study<sup>®</sup> compared avocado oil to losartan, a blood pressure medication, for 45 days. It found that avocado oil reduced diastolic and systolic blood pressure by 21.2% and 15.5%, respectively, and had similar effects to losartan in reducing blood pressure.

Another rat study found that avocado oil was effective in reducing levels of triglycerides and LDL (bad) cholesterol and did not affect HDL (good) cholesterol.

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While these results are promising, larger human clinical trials are still needed.



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## High in lutein, an antioxidant that has benefits for the eyes

Avocado and its oil are relatively good sources of lutein, a carotenoid and antioxidant that's naturally found in your eyes.

Research has shown that a diet rich in lutein and another carotenoid called zeaxanthin is essential for eye health and may reduce the risk<sup>9</sup> of cataracts and macular degeneration, which are common age-related eye diseases.

Since your body doesn't produce lutein on its own, you must obtain it from your diet. Fortunately, adding avocado and avocado oil to your diet is a great and easy way to support your eye health.

## Enhances the absorption of important nutrients

Some nutrients need to be combined with fat to allow your body to absorb them, such as the fat-soluble<sup>9</sup> vitamins A, D, E, and K.

Adding avocado oil or another type of fat to your meal may help you better absorb these nutrients.

One small study<sup>9</sup> found that adding avocado oil to a salad with carrots, romaine lettuce, and spinach increased the absorption of carotenoids. The increase was substantial — 4.3- to 17.4-fold — when compared with a salad without fat.

Other studies have shown that olive oil, which has a very similar oleic acid content to avocado oil, is highly effective in increasing the bioavailability of carotenoids.

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Therefore, adding avocado oil to a salad, marinade, or other dish may help your body absorb more nutrients.



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## May reduce symptoms of arthritis

Arthritis is a very common disease that involves painful inflammation of the joints. It affects millions<sup>®</sup> of people worldwide.

While there are many types of arthritis, the most common type is osteoarthritis, which is associated with the breakdown of cartilage in the joints.

Numerous studies<sup>®</sup> have found that extracts from avocado and soybean oil, called avocado/soybean unsaponifiables (ASU), may reduce the pain and stiffness associated with osteoarthritis.

You can find ASU supplements in most wellness stores and online. But be sure to speak with a healthcare professional to make sure it's right for you.

## Rich in antioxidants

A diet rich in antioxidants helps fight free radicals, which are unstable compounds that can damage cells over time. When an imbalance occurs, this can lead to oxidative stress.

Fortunately, avocado oil contains a large number of antioxidants to benefit your health, such as carotenoids, tocopherols (forms of vitamin E), and various plant sterols.

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## The takeaway

Avocado oil is delicious, nutritious, and easy to use.

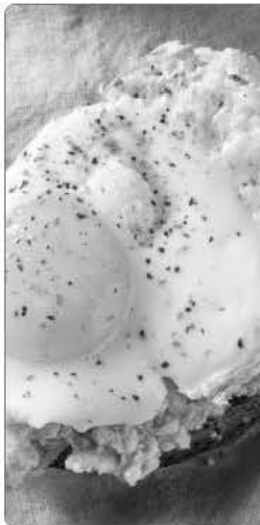
It's rich in oleic acid (a monounsaturated fat), polyunsaturated fats, carotenoids, and other antioxidant-rich nutrients that are linked to improved heart, skin, and eye health.

You can easily add it to your diet in a salad, as part of a dip or marinade, or as a replacement for most other plant oils.

If you're looking to switch things up, give avocado oil a try.

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GET STARTED

Last medically reviewed on November 11, 2024

## How we reviewed this article:

SOURCES HISTORY

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Our experts continually monitor the health and wellness space, and we update our articles when new information becomes available.

# EXHIBIT 7





[Home](#) / [Recipes + Tips for Healthy Living](#) / [Avocado Oil as a High Heat Cooking Oil](#)

## AVOCADO OIL AS A HIGH HEAT COOKING OIL

Chosen Team



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- [Cheesy Savory Christmas Wreath](#)
- [Snowflake Sugar Cookies](#)
- [Beef Tamales](#)
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Chosen Foods naturally refined, expeller-pressed [avocado oil](#) is the perfect high heat cooking oil. With health benefits similar to olive oil, a smoke point high enough to avoid toxins and trans fats and low in polyunsaturated fat, there isn't another oil available that is better for high heat applications.

## VIRGIN VS REFINED AVOCADO OIL

### REFINED AVOCADO OIL

Chosen Foods naturally refined expeller-pressed avocado oil has a smoke point of 500°F. This smoke point allows you to safely sear, sauté, stir-fry, barbecue and even bake at high temps without your oil breaking down. We consider refined avocado oil a kitchen workhorse.

### VIRGIN AVOCADO OIL

[Virgin avocado oil](#), while beautiful in color and also very healthy, does not have as high of a smoke point. It is common to see all avocado oil listed with a 500 plus degree smoke point, with no differentiation between virgin and refined. We love virgin avocado oil and its many purposes but want to set the record straight. Only a refined avocado oil can reach a 500-degree smoke point. Virgin avocado oil comes in at 350-375 degrees, similar to olive oil. With it's bold flavor, virgin avocado oil is great for salad dressings, drizzling's, marinades, and gentle cooking. We consider it more of a finishing oil.

## THE CONSEQUENCES OF THE WRONG OIL FOR HIGH HEAT COOKING

Another important thing to consider with choosing a high heat cooking oil is its polyunsaturated fat content. Oils that are high in polyunsaturated fats should never be heated, regardless of their smoke point. This is due to them being highly reactive & unstable when being affected by heat. The longer the oil is heated, the more negative effects it could have.

Typical polyunsaturated oils include corn, soy, sunflower, grapeseed, safflower, and rice bran. Refined versions of these oils are all advertised as high heat cooking oils. Avoid them, they should have no place in any healthy kitchen. Especially try to avoid them at restaurants and fast-food chains where the likelihood of the oil being incredibly rancid is much higher. For more healthier food that contain polyunsaturated fats, try incorporating wild fish & chia seeds into your diet.

## RECOMMENDED HIGH HEAT COOKING OILS

Instead, choose oils high in monounsaturated and saturated fats. They are much more stable and suitable for high heat cooking. These include avocado, olive, coconut, peanut, high oleic sun/safflower and canola oil.

## HOW OIL IS PROCESSED

The last thing to consider when choosing a high heat cooking oil is how the oil was processed. Even though canola oil and peanut are high in monounsaturated fat and have a relatively high smoke point, they are often refined in very unhealthy ways.

## RECOMMENDED HIGH TEMPERATURE COOKING OILS

Choose oils that are either cold-pressed and virgin, or expeller-pressed and naturally refined. Chosen Foods avocado oil is naturally refined and expeller pressed.

## HERE ARE THE THREE THINGS YOU SHOULD LOOK FOR IN YOUR OILS:

### 1. DOES IT HAVE A HIGH ENOUGH SMOKE POINT FOR MY COOKING NEEDS?

Low Heat Cooking Oils:

- Extra Virgin Olive Oils
- Coconut Oil
- Grapeseed Oil
- Canola Oil

High Heat Cooking Oils:

- Canola Oil
- High Oleic Safflower Oil
- Avocado Oils

### 2. IS IT MONO OR SATURATED FAT AND HAVE LOW POLYUNSATURATED FAT LEVELS?

Check the labels on the back of your cooking oil to really understand how it's made.

### 3. WAS IT EITHER COLD-PRESSED OR EXPELLER-PRESSED AND NATURALLY REFINED?

Familiarize yourself with the brand & their website to really understand their processes.

If you intend to sear, stir-fry, barbecue, broil, deep-fry, bake or roast at a temperature higher than 400 degrees, Chosen Foods naturally refined avocado oil is the absolute best option available. With a 500-degree smoke point, stable monounsaturated fats, make it your go-to, high-heat, naturally refined cooking oil.

Interested in trying for yourself? Shop [Chosen Foods High Heat Avocado Oil](#).

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# EXHIBIT 8



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# Canola Oil vs. Vegetable Oil: What's Healthiest?



Medically reviewed by  
**Katherine Marengo LDN,  
R.D., Nutrition** — Written by  
**Sagan Morrow** — Updated  
on September 21, 2023

[Canola oil](#) | [Vegetable oil](#) | [Safe storage](#) | [Other oils](#) | [Takeaway](#)

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Canola and vegetable oil may seem interchangeable, but they actually have different qualities when it comes to nutrition and best use.

Most of us use some type of oil every day while cooking. Do you know which types of oil are the healthiest for you and which ones are the best to use in different types of cooking?

## Canola oil



d3sign/Getty Images

When looking at different types of oil, keep three things in mind:

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1. its smoking point (the temperature at which the oil starts to break down, making it unhealthy)
2. the type of fat that it contains
3. its flavor

[Canola oil](#) can be heated to a variety of temperatures, and it has a neutral taste.



Both monounsaturated and polyunsaturated fats can improve cholesterol levels and lower your risk of heart disease. Saturated fat, which is more prevalent in animal products and also found in coconut and palm oil, raises blood cholesterol levels.

It's better to limit the amount of saturated fat in your diet.


Canola plants are a variety of the rapeseed plant that have been crossbred to remove most of a toxic substance called erucic acid from their seeds. The seeds are harvested, then pressed and treated with hexane to draw out as much oil as possible.

Most canola<sup>🌱</sup> planted in the US is genetically modified for herbicide resistance. There is also some controversy about whether GMOs are safe in the long term. Long-term safety studies aren't yet available, and there is still debate over whether GMOs are healthy or unhealthy.

Nevertheless, the FDA, EPA, and USDA have all ensured<sup>🌱</sup> that GMOs are safe for human, plant and animal health.

The important thing is to be aware of whether your foods contain GMO ingredients or not. Make your choice with that knowledge!

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## Vegetable oil

Vegetable oil is often a mix or a blend of different types of oils. It's a more generic type of oil that many people use in their everyday cooking. Vegetable oil is often an inexpensive choice that can be used for all kinds of cooking. And like canola oil, it has a neutral flavor.

The problem with this type of generic oil is that you're less likely to know exactly what's in your oil. This includes how the plants from which the oil was extracted were grown and how the oil was processed.

Also, the vegetable oil sold in grocery stores in the US is mainly soybean or corn oil or a combination of the two, which are both almost always<sup>🌱</sup> genetically modified. So in fact, both foods are almost equally likely to be GMO products.

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The ratio of saturated fat, polyunsaturated fat, and monounsaturated fat varies depending on what oils have been included in the blend (sunflower, corn, soy, safflower, etc.), so you won't have as much control over the types of fats you're eating.

## Safe storage of cooking oil

Unfortunately, cooking oils can be prone to going rancid, particularly when exposed to oxygen. When oxygen interacts with the compounds in oils, it results in the breakdown of peroxides. This can give cooking oils an unpleasant smell or taste.

With time, the oxygen can contribute to a greater number of [free radicals](#). These are potentially harmful compounds that have been linked to cell damage and potentially to causing cancer. As a result, it's important that you take care where you store your cooking oils and how long you store them.

Most cooking oils should be kept in a cool, dry place. In particular, keep them away from heat (above or too close to the stove) and sunlight (in front of a window).

Wrap clear glass bottles of oil in aluminum foil or another material to keep light out and to extend the life of the oil.

If you purchase a large bottle of oil, you may wish to transfer some oil to a small bottle that you'll use more quickly. The rest can be stored in the refrigerator or in a cool place away from sunlight.

If you purchase cooking oils that contain herbs and vegetables (such as chili peppers, [garlic](#), tomatoes, or mushrooms), they can be prone to bacterial growth, including *Clostridium botulinum* bacteria (which can cause [botulism](#)).

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Oils with this kind of mixture should be refrigerated after opening and used within four days after opening for maximum freshness and taste.

Generally, most cooking oils go bad in about three months. That's more incentive to go ahead and cook healthy foods with them.



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## Other healthy oils



## Avocado oil

Avocado oil has a high smoke point. This means that it's ideal for searing, browning, or baking foods. Avocado oils are high in monounsaturated fats, with polyunsaturated fats about half those of monounsaturated.

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The oil can be costly because it takes many avocados to create even a small amount of oil. However, it has an excellent, neutral flavor that makes it ideal for adding to soups, drizzling over fish or chicken before baking, or mixing with vegetables for roasting.

## Extra virgin olive oil

Full of good-for-you monounsaturated fat, olive oil is best used at medium- or low-heat cooking temperatures.

When you choose good-quality extra-virgin olive oil, the flavor is excellent, making it a great choice for salad dressings.

## Coconut oil

While coconut oil may be high in saturated fats, it also has a beneficial effect on a person's high-density lipoprotein (HDL) levels. HDL is also known as a person's "good" cholesterol, which works to reduce levels of unwanted high cholesterol.

However, because coconut oil is so high in saturated fats, most health experts recommend using it sparingly. Coconut oil has a medium smoke point, making it best for using with low-heat baking and sautéing.

## Grapeseed oil

Grapeseed oil has a smoke point that's medium high, meaning that you can use it safely for a variety of different types of cooking.

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This type of oil is high in omega-6 fatty acids, a type of polyunsaturated fat that needs to be balanced with omega-3s, another type of polyunsaturated fat.

It's a good idea to increase your intake of other foods that include a higher ratio of omega-3 to omega-6 fats in your diet to compensate.

## MCT oil

Medium chain triglycerides (MCT) oil is a cooking oil known to be low in calories and is an excellent source of energy for the body. As a result, some athletes use MCT oil to enhance athletic performance.

However, if a person simply chooses to consume MCT oil by the tablespoon, they should start in small doses. Eating too much at a time is associated with nausea.

Was this article helpful?

Yes

No

Also, don't heat the oil higher than 150 to 160 degrees and lose the taste. Many people enjoy MCT oil as a salad dressing (and, no doubt, are happy to avoid keeping track of the oil's temperature on the stove).

## Peanut oil

**Peanut oil** is a flavorful oil high in **resveratrol**, a compound that helps to fight heart disease and reduces a person's cancer risk. This oil is well-balanced in terms of monounsaturated and polyunsaturated fats.

It has a medium-high smoke point, which makes it ideal for stir-frying, baking, or cooking dishes in the oven.

## Sesame oil

With a more balanced ratio of monounsaturated and polyunsaturated fats, sesame oil is best used when heated only very lightly or not at all. You can also use it in salads and no-cook dishes to preserve the nutrients.

## Takeaway

You can get other kinds of gourmet oils too, like macadamia nut oil! Don't be afraid to get creative.

As you can see, when trying to choose a healthy oil, one of the best things you can do is to enjoy a variety of oils that are higher in monounsaturated and polyunsaturated fats and lower in saturated fats.

The more variety you have in your diet with the types of fats you consume, the more nutrients you get.



*Sagan Morrow is a freelance writer and editor as well as a professional lifestyle blogger at [SaganMorrow.com](https://SaganMorrow.com). She has a background as a certified holistic nutritionist.*

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Last medically reviewed on September 21, 2023

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### Current Version

#### Sep 21, 2023

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#### Sep 30, 2018

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Sagan Morrow

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# Olive Oil vs. Canola Oil: Which Is Healthier?

[What are they](#) | [Nutrition](#) | [Uses](#) | [Recommendation](#) | [Bottom line](#)

Canola oil and olive oil are two of the most popular cooking oils worldwide.

They are both promoted as heart-healthy and share similar uses. However, some people wonder how they're different and which is healthier.

This article explains the differences between canola and olive oil.

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## What are canola oil and olive oil?

Canola oil is made from rapeseed (*Brassica napus* L.) that has been bred to be low in toxic compounds like erucic acid and glucosinolates, which rapeseed naturally contains. This engineering makes [canola oil](#) safe for consumption (1).

Canola processing generally involves heating, pressing, chemical extraction, and refining, but expeller and cold-pressed canola oil is also available. The oil also undergoes bleaching and deodorizing, which give it a neutral color and odor (2).

On the other hand, olive oil is made from pressed olives, the fruits of the olive tree.

While many types exist, the two most popular are regular or “pure” olive oil and extra virgin olive oil.

Extra virgin olive oil is extracted using only pressing, while regular olive oil contains a combination of virgin (pressed) oil and refined (heated or chemically

Although **extra virgin olive oil** is more expensive than regular olive oil, it is considered healthier because it's less refined.

## SUMMARY

Canola oil is made from selectively bred rapeseeds. Meanwhile, olive oil is made from pressed olives and come in several forms.

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## Similar nutritional profile

In terms of nutrients, canola and **olive oil** are quite similar.

The nutrients in 1 tablespoon (15 ml) of canola and regular (refined) olive oil are (5, 6):

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	Canola	Olive
Calories	124	124
Fat	14 grams	14 grams
• Saturated	7%	14%
• Monounsaturated	64%	73%
• Polyunsaturated	28%	11%
Vitamin E	16% of the RDI	13% of the RDI
Vitamin K	8% of the RDI	7% of the RDI

Notably, olive oil provides more **saturated** and **monounsaturated** fat, whereas canola oil contains more polyunsaturated fat.

## Antioxidant content

Canola and olive oil differ significantly in their content of **antioxidants**, compounds that neutralize potentially harmful molecules called free radicals.

Free radicals are highly unstable and can cause cellular damage when levels get too high in your body. Studies link free radical damage to chronic illnesses, such as heart disease, diabetes, Alzheimer's, and certain cancers (7<sup>6</sup>).

Olive oil boasts over 200 plant compounds, including polyphenols, which act as powerful antioxidants in your body (8<sup>6</sup>).

However, the amount of polyphenols depends on the processing method (9<sup>6</sup>).

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Because the refining process significantly reduces antioxidant content, regular olive oil has a low polyphenol count. Meanwhile, extra virgin olive oil is packed with polyphenols (1<sup>6</sup>, 2<sup>6</sup>, 9<sup>6</sup>).

These include oleuropein, hydroxytyrosol, and oleocanthal, which are linked to a lower risk of heart disease and reduced inflammation (10<sup>6</sup>).

#### SUMMARY

Olive oil and canola oil have similar amounts of fat and calories but a different fatty acid composition. Olive oil — especially extra virgin — is also higher in antioxidants than canola oil.

## Culinary uses

# EXHIBIT 9





# EXHIBIT 10



# EXHIBIT 11

1500 Lakeside Parkway Suite 100  
Flower Mound, TX 75028  
Phone (972) 241-8374  
Fax (972) 241-0619  
[www.ceuticallabs.com](http://www.ceuticallabs.com)

CUSTOMER NAME	Dovel & Luner LLP (CLM0000)
ATTENTION OF	Rick Lyon
REPORT DATE	1-7-25
CEUTICAL LABS PROJECT #	59028
ANALYST NAME	R. Robles / I. Wang / D. Treybig
ANALYSIS REQUESTED	Appearance, FTIR, Peroxide Value, Acidity, Fatty Acid Profile (13 FFAs from C14 to C24), Tocopherols ( $\alpha$ , $\beta$ , $\gamma$ , $\delta$ ), Sterols Profile, Chlorophylls, [K232, K270, $\Delta K$ ]
METHODS	USP-NF2024, Food Control 143 (2023) 109277
SAMPLE TYPE	Finished Product

SAMPLE IDENTIFICATION	CL LAB ID
Avocado Oil (Walmart), Lot # L-A4276N-292-7	CU807

TEST	REQUIREMENT	RESULT
Appearance	A Yellow to Slight Green Color	Conforms
FTIR	Conforms to Standard	Conforms
Peroxide Value	Report Result	3.65 mEq/g
Acidity	Report Result	0.08 %
C14:0	Not Detected-0.3 %	9.62 %
C16:0	11.0-26.0 %	12.34 %
C16:1	4.0-17.1 %	Below Detectable Limits
C17:0	Not Detected-0.3 %	Below Detectable Limits
C17:1	Not Detected-0.1 %	Below Detectable Limits

FO-012-F  
Effective : August 25, 2022





C18:0	0.1-1.3 %	Below Detectable Limits
C18:1	42.0-75.0 %	Below Detectable Limits
C18:2	7.8-19.0 %	13.87 %
C18:3	0.5-2.1 %	0.68 %
C20:0	Not Detected-0.7 %	Below Detectable Limits
C20:1	Not Detected-0.3 %	14.41 %
C22:0	Not Detected-0.5 %	14.59 %
C22:1	Not Detected	5.35 %
C22:2	Not Detected	14.79 %
C22:3	Not Detected	14.35 %
C24:0	Not Detected-0.2 %	Below Detectable Limits
$\alpha$ -Tocopherol	70-190 mg/ kg	120.93 mg/ kg
$\delta$ - Tocopherol	70-190 mg/ kg	15.62 mg/ kg
$\gamma$ + $\beta$ - Tocopherol	70-190 mg/ kg	40.63 mg/ kg
Total Tocopherols	70-190 mg/ kg	177.2 g/ kg
Campesterol	Report Result	7.88 %
Stigmasterol	Report Result	0.39 %
$\beta$ -Sitosterol	Report Result	91.73 %
Total Sterols Profile	Report Result	100.00 %
Chlorophylls	Report Result	0.243 ppm
K232	1.4-3.5	1.8
K270	0.4-1.6	0.9
$\Delta$ K	Report Result	0.1075

Technical Review

Date

Quality Review

Date

The results stated above are provided with the most accurate method available. However, the test method has not been validated to current USP and ICH guidelines for this product. Method validations are the responsibility of the manufacturer for each product

# **EXHIBIT M**

# Nov 14, 2021 order | Order# 5892143-705357

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Delivery

**Delivered on Nov 16**

Delivery

**1 item**

Great Value Refined Avocado Oil, 25.5 fl oz

**\$8.23**

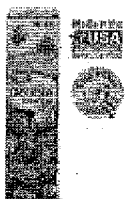
Qty 1

[Add to cart](#)[Review item](#)

## More from this order



Delivery from store

**Delivered on Nov 16****1 item**Great Value Fresh Seal Double Zipper Storage  
Bags, Gallon, 60 Count**\$2.97**

5.0¢/ea

Qty 1

# **EXHIBIT N**

*Target*

## Order details

#102000234915620

Placed at 11:30 PM on Oct 9, 2023

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**Buy it again**

Choose items from this purchase to buy again

**Get help**

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### Picked up

Order Pickup at Woodland Hills

**Roma Toma...**

\$1.39

Qty 1

**Sandwich B...**

\$1.39

Qty 1

**Chosen Foods 1...**

\$13.79